Turkey: State of the Art in Computer Graphics — The Turkish Scene

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Introduction

Computer graphics has been known and, in a formal or informal manner, been studied and applied in many areas ever since the early 1970s. The earliest examples of research work with some results, even though not necessarily commercialized, came from Istanbul Technical University and the Middle East Technical University. The former institution devoted most of its efforts towards computer-aided architectural design whereas in the second institution, more theoretical computer graphics work has been carried out. Two examples can be given on the theoretical work: A hidden line elimination algorithm by Ibrahim Canbulat, and an automated drafting algorithm by the author [4, 13].

The two mentioned institutions gradually increased their efforts in the employment of computer graphics as a tool (rather than a research area) in many of their engineering departments, again primarily for computer-aided design research and development. The earliest official computer graphics course was offered by the Middle East Technical University in 1979. The school had conducted some research related to graphics, one noteworthy example being the automated drafting of the HVAC fixtures of the largest manufacturer of such products in Turkey.

After the second half of the 1980s, computer graphics research, development and application gained a great momentum. Many private industries, mostly the aerospace, broadcasting and advertising industries, employed graphics development in their business, and recently some have started to produce their own software as well. With the establishment of Bilkent University, the first private university in Turkey, computer graphics became an official track of study, not only in computer engineering, but in the fine arts as well.

In this paper, we will examine the current state of computer graphics in Turkey under two main headings. First, the educational institutions and their research work will be examined. Some of these works are carried out as applied research projects and the results may be in commercial use. Then, the industry will be examined as developers as well as end users of advanced computer graphics hardware and software.

Computer Graphics Research and Applications in the Universities

With its establishment, computer graphics became a field of study at Bilkent University, Department of Computer Engineering and Information Science. Actually, the very first doctorate degree granted by the department and the related graduate school was on a computer graphics dissertation [1]. Research started mainly on two major areas of interest in computer graphics. Initial work was related to rendering techniques extending to texture mapping, ray tracing and radiosity. The university purchased Sun and Silicon Graphics workstations on which the earlier versions of this work was carried out.

The second area of interest was that of animation of legged objects as well as physically based animation. Advanced software techniques, such as object oriented programming, were also applied to the software produced. Three projects, one on human motion animation (Figure 1, [12]), another on object oriented motion abstraction (Figure 2, [7]) and the third one on solid deformations (Figure 3, [8]) are examples of this initial phase of the studies. Other research related to the ray tracing of complex objects (Figures 4, 5, and 6), and the simulation of natural objects by fractal geometries (Figure 7) were simultaneously carried out.
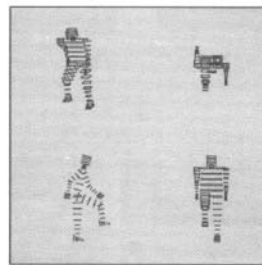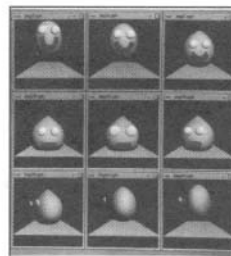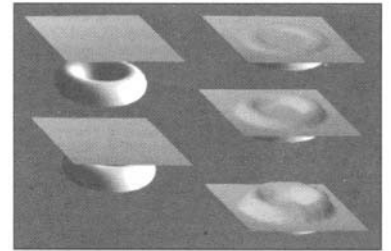

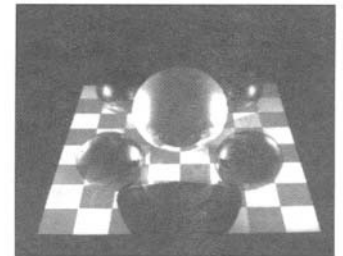Figure 3: Animating with solid deformations.

Figure 4: Simple ray tracing.
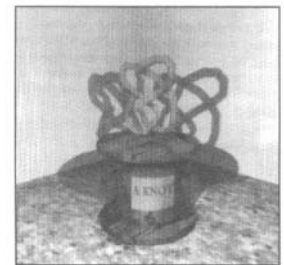
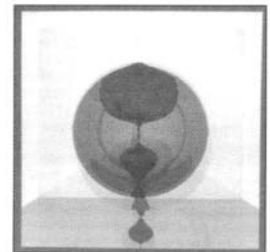Figure 5: Ray tracing textured objects.

Figure 6: Ray tracing transparent sweep surfaces.

Figure 1: Semi-goal directed human motion animation.

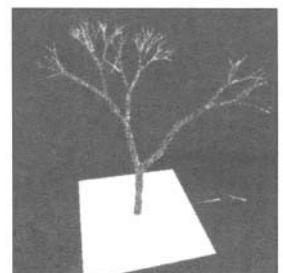Figure 2: Object oriented motion abstraction.

Figure 7: Fractal tree growth.

A later stage of research oriented itself more to parallel software development. Both radiosity algorithms and ray tracers were implemented using parallel software run on an Intel Hypercube (Figures 8 and 9, [9, 5]). The main objective of the research conducted to this end was in developing the spatial subdivision techniques that led to the efficient subdivision of spatial data to every processor for both load balancing and elimination of excessive communication between processors.
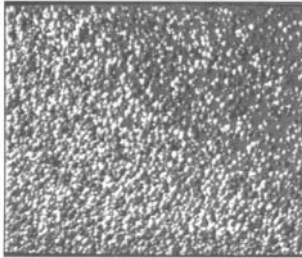

Figure 8: Parallel ray tracing.

Figure 9: Parallel radiosity.

Another project carried out on the Intel Hypercube was an animation development using parallel z-buffers for rendering and coherence analysis (Figure 10, [2]). The new research trends are more towards scientific visualization and, through various grants, the university has acquired new parallel machines on which such projects are carried out. Some research projects at the Electrical and Electronics Engineering Department are related to facial animation for the transmission of video signals over low speed telephone wires (Figure 11, [3]).
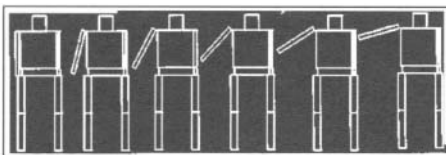
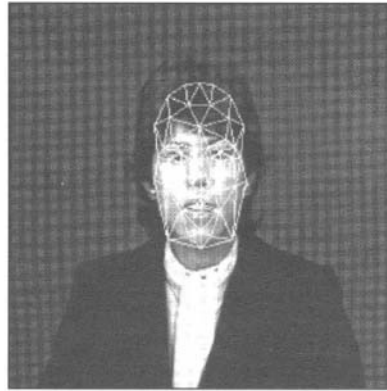

Figure 10: Coherency in an animation.

Figure 11: Facial animation.

Most of the graphical work currently carried out at the Middle East Technical University is related to CAD/CAM in the Department of Mechanical Engineering. At the CAD/CAM and Robotics Center of the department, extensive research and software development on the behavior of machine parts and robot arms are carried out. Robot arms that are capable of handling different type of materials and robots with infrared vision are examples of such developments, presented using computer graphics techniques (Figures 12, 13, [11]). An interesting project at the center is the automated design of the sole for sports shoes (Figure 14, [10]).
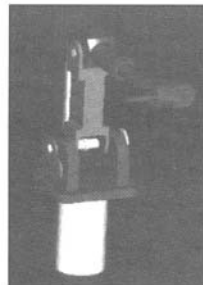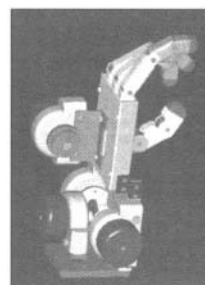

Figure 12: Infrared vision robot.

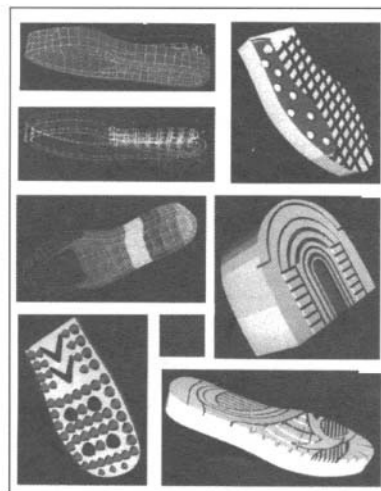Figure 13: Robot with four fingers.

Figure 14: Automated shoe design.

Anadolu University, a rather new state university, has invested a great deal in graphic design, TV/video graphics and production. One noteworthy mission of the university is to prepare all the course work for the open university system in Turkey that depends heavily on video graphics and multimedia. The university also provides support to various private or state TV/broadcast companies in Turkey.

At the Department of Graphic Design of Anadolu University, there are two different programs that support computer graphics education. The first one is the graphic design courses with computer support. These courses are scheduled for eight hours a week during which computer graphics laboratories are extensively used. The other heavily computer supported track of study is the publication graphics courses where the student learns the principles of document design and desktop publishing.

The Department of Animation at the same university comprises of two tracks: one on conventional animation, and the other on computer animation. Computer animation courses start at freshman level and continue until graduation. Software used includes two- and three-dimensional animation packages, digital imaging and video packages, line test systems and multimedia applications (Figure 15).
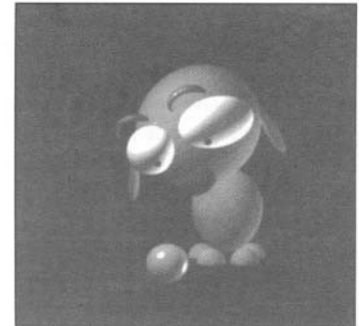
Figure 15: Animation by Hale Özdemir, Anadolu University.

Multimedia Research by the Scientific and Technical Research Council of Turkey

A very interesting research project carried out by the Institute of Information Technologies of the Scientific and Technical Research Council of Turkey is the multimedia recreation of the antique Ephesus Theater. The visitor to the electronic version of the site first has a chance to view the current ruins through video. Selecting particular buildings from this digitized video film, the animation part of the multimedia environment is invoked in which the visitor can walk through the original version of the historical building. The animations are based on the

results of the archaeological discoveries and on historical facts. Interaction is provided by touch-sensitive screens. (Figures 16 and 17).
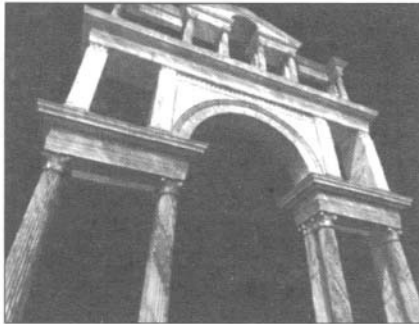

Figure 16: Digitally reconstructed Ephesus Theater.

Figure 17: Digitally reconstructed Ephesus Theater.

Computer Graphics: The Industrial Scene

Traditionally, mechanical engineering, as well as electrical and electronics engineering, firms have been users, developers and researchers of computer graphics. A more recent, but by no means the smallest newcomer to the scene, is the advertising, broadcast and film industry. Most of the advanced computer graphics and multimedia applications and developments come from this latter industry. The major users of computer graphics in advertising and broadcasting industries are the post-production houses in Istanbul. The location is very logical since nearly all of the mainstream TV channels are located in Istanbul. More advanced work is done for the post-production of TV advertisements with some less voluminous work for presentation videos of bigger firms.

The leading house, among the ones that execute eye-catching productions and in terms of its usage of more recent technologies in computer graphics as well as its company portfolio, is Telesine, established in 1981. Currently the firm is doing both production and post-production. The company has recently bought a state of the art traditional animation system in addition to a wealth of

advanced workstations for advanced 3D animation. Live footage and paint systems are brought together here with the ability to experiment by trial and error on the final look of the project, in real time.

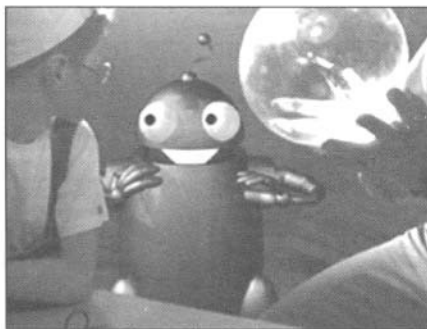Figure 18: Sample of graphics produced by Telesine.

Figure 19: Sample of graphics produced by Telesine.

An ongoing project of the company is to construct a motion capture studio to accomplish a virtual studio environment for the TV channels. The director of the Computer Graphics Department of the company is very enthusiastic about creating such a system for virtual reality applications ranging from virtual studio to 3D game development.

The other leading company on the stage is the Computer Graphics Department of IMAJ TV. Its main area of production is in video editing. They provide editing services 24 hours a day in several editing suites. There are currently 3D animation and paint systems in use there also.

Akangörüntüler, another innovative firm, has many titles in its portfolio in advertising.

There are several other places in Istanbul doing computer graphics (First, Frame, Planet, SGS, Indigo2), but their content and production is limited in creating innovative productions. The TV channels hold much equipment to provide graphics for broadcast, but again these are quite limited in content. Generally private TV channels invest in the area of computer graphics.

Engineering companies with design oriented work have produced some software, and use advanced graphics techniques in their product development. We shall give two examples of

this. An Ankara based company, SAMTEK-ITC is one of the examples of research oriented firms where software production takes place. One of the products of this company is a multimedia CD about Turkey. Similar products have been developed by other companies as well, such as 3. Boyut in Istanbul. The primary product of SAMTEK-ITC is, however, a piece of software called GEMS, a geometry modeling and mesh generation system. This product has gained an international reputation (Figure 20, [6]).
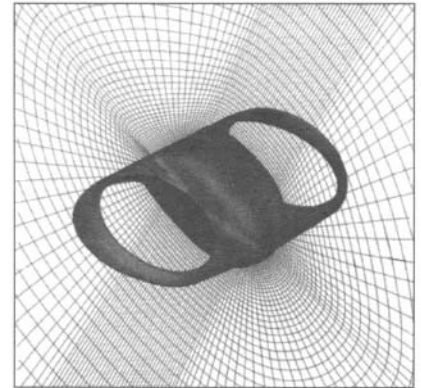

Figure 20: A mesh generated by GEMS.

Turkish Aerospace Industries (TAI) use computer graphics heavily in the design of aircraft. Body and wing designs are carried out in their Avionics and Aerodynamic Departments, whereas the models are tested with fluid dynamics programs in the Structure Analysis Department. Those models not satisfying structural tests and/or design requirements, are sent back to the design departments for reevaluation.

Conclusion

The examples outlined in this paper by no means describe the only computer graphics work being carried out in Turkey. They, however, do represent either original software developments and/or advanced applications. In addition to various industry giant mainframe and workstation manufacturers, most of the advanced graphics hardware companies are represented in the country. Of course, personal computers of all kinds also are widely available. Simpler and smaller graphics software is available over-the-counter, whereas large scale programs are imported upon demand from various European, American and Japanese firms. The interest is steadily increasing, especially with a series of articles published in Bilim ve Teknik (Science and Technology), the most popular science journal in Turkey published by the Scientific and Technical Research Council. The state television also has a popular science series in which computer graphics will be studied in great detail, again supported by the Scientific and Technical Research Council of Turkey.

The Turkish Information Technology Market

1995 (January-September) Information Technology Market
(Thousand USD)

	Income	Percent in Total
Hardware	456,000	73.0
Software	65,000	10.4
Services	91,000	14.6
Supplies	13,000	2.1
Total	625,000	100.0

Information Technologies (Twelve months)
(Thousand USD)

	1993	1994*	1995 (Estimated)
Sales	901,229	611,492	964,000

(*) In 1994, Turkey experienced an economic slow down due to financial problems. Legislation by the Parliament stopped most of the government funded spending and placed restrictions on imports.

1995 Hardware Sales (Last three months estimated)
(Thousand USD)

	Total	% in Total Sales
Main Frame and Mini-Midi Systems	147,000	21.3
Personal Computers	304,000	44.1
Communication Systems	42,000	6.1
Printers	72,000	10.4
ATM	18,000	2.6
Others	107,000	15.5
Total	690,000	100.0

1995 Workstation Market (Estimated)
(Thousand USD)

	Total
Sales incomes	9,000

1995 (January-September) Workstation Sales in Numbers

HP	193
DEC	74
Sun	90 (Estimated)
IBM	35
SGI	60 (Estimated)
Others	148 (Estimated, including DG Avion, Intergraph and clones)

Courtesy of INTERPRO Publication, Research and Organization Inc., Istanbul, Turkey

References

1. V. Akman and A. Arslan. "Sweeping with all graphical ingredients in a topological picture-book," *Computers & Graphics*, 16(3), 1992, pp. 273-281.
2. Aktihanoglu, M. et al. "MARS: A Tool Based Modeling, Animation and Parallel Rendering System." *The Visual Computer*, 11, 1994, pp. 1-14.
3. Bozdagi, G., A. M. Tekalp and L. Onural. "3-D Motion Estimation and Wireframe Adaptation Including Photometric Effects for Model-Based Coding of Facial Image Sequences." *IEEE Trans. on Circuits and Systems for Video Technology*, 4(3), 1994, pp. 246-256.
4. Canbulat, I. "Perspective Drawings with a Computer." Electronic Information Processing, Proceedings of the Istanbul Technical University Symposium, 1977, pp. 175-198, (in Turkish).
5. Çapin, T., et al. "A Parallel Progressive Radiosity Algorithm Based on Patch Data Circulation." *Computers & Graphics*, 20(2), 1996.
6. Dener, C., E. Koc and Çl. Sirin. "An Object Oriented Approach for Intelligent Topology Definition and Automatic Grid Generation." Proceedings of the 33rd Aerospace Sciences Meeting and Exhibit, Reno, Nev., (1995).
7. Erkan, B. and B. Özgüç. "Object Oriented Motion Abstraction." *The Journal of Visualization and Computer Animation*, 6(1), 1995, pp. 49-65.
8. Güdükbay, U., et al. "An Animation System for Rigid and Deformable Models." *Computers & Graphics*, 17(1), 1993, pp. 71-77.
9. Isler, V., et al. "An Efficient Parallel Spatial Subdivision Algorithm for Parallel Ray Tracing Complex Scenes." *Computer Aided Design*, 26(12), 1994, pp. 883-890.
10. Kaftanoglu, B. and Ç. Enöz. "Computer Aided Design and Analysis of Sport Shoe Soles." *The Journal of Machine Design and Manufacture*, 3(1), 1995, pp. 19-29.
11. Konukseven, E. I. and B. Kaftanoglu. "Interactive Graphical Robot Programming and Simulation." ICARCV'92, Proceedings of the Second International Conference on Automation, Robotics and Computer Vision, Singapore, Sept. 1992, pp. RO 7.3.1-RO 7.3.7.
12. Mahmud, S. K. and B. Özgüç. "Semi-Goal Directed Animation: A New Abstraction of Motion Specification in Parametric Key-Frame Animation of Human Motion." Proceedings of the Second Eurographics Workshop on Animation and Simulation, Vienna, Austria, Sept. 1991, pp. 75-88.
13. Özgüç, B. and M. Pultar. "A Computer Graphics Program for Architectural Drafting." *METU Faculty of Architecture Journal*, 5(2), 1979, pp. 269-285.

Bülent Özgüç joined the Department of Computer Engineering and Information Science of Bilkent University, Faculty of Engineering, Turkey, in 1986. He is a Professor of computer science and the Dean of the Faculty of Art, Design and Architecture. Formerly, he has taught at the University of Pennsylvania, U.S.A., Philadelphia College of Arts, U.S.A. and the Middle East Technical University, Turkey, and he worked as a member of the research staff at the Schlumberger Palo Alto Research Center, U.S.A.

For the last 17 years, he has been active in the field of computer graphics and animation. He received a B. Arch. and an M. Arch. in architecture from the Middle East Technical University in 1972 and 1973. He received an M.S. in architectural technology from Columbia University, U.S.A., and a Ph.D. in a joint program of architecture and computer graphics from the University of Pennsylvania in 1974 and 1978, respectively. He is a voting member of IUA and ACM, and an affiliate of IEEE. He has edited three books and a special issue of a journal, published more than 40 articles in conference proceedings, three chapters in books and 20 journal articles.

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