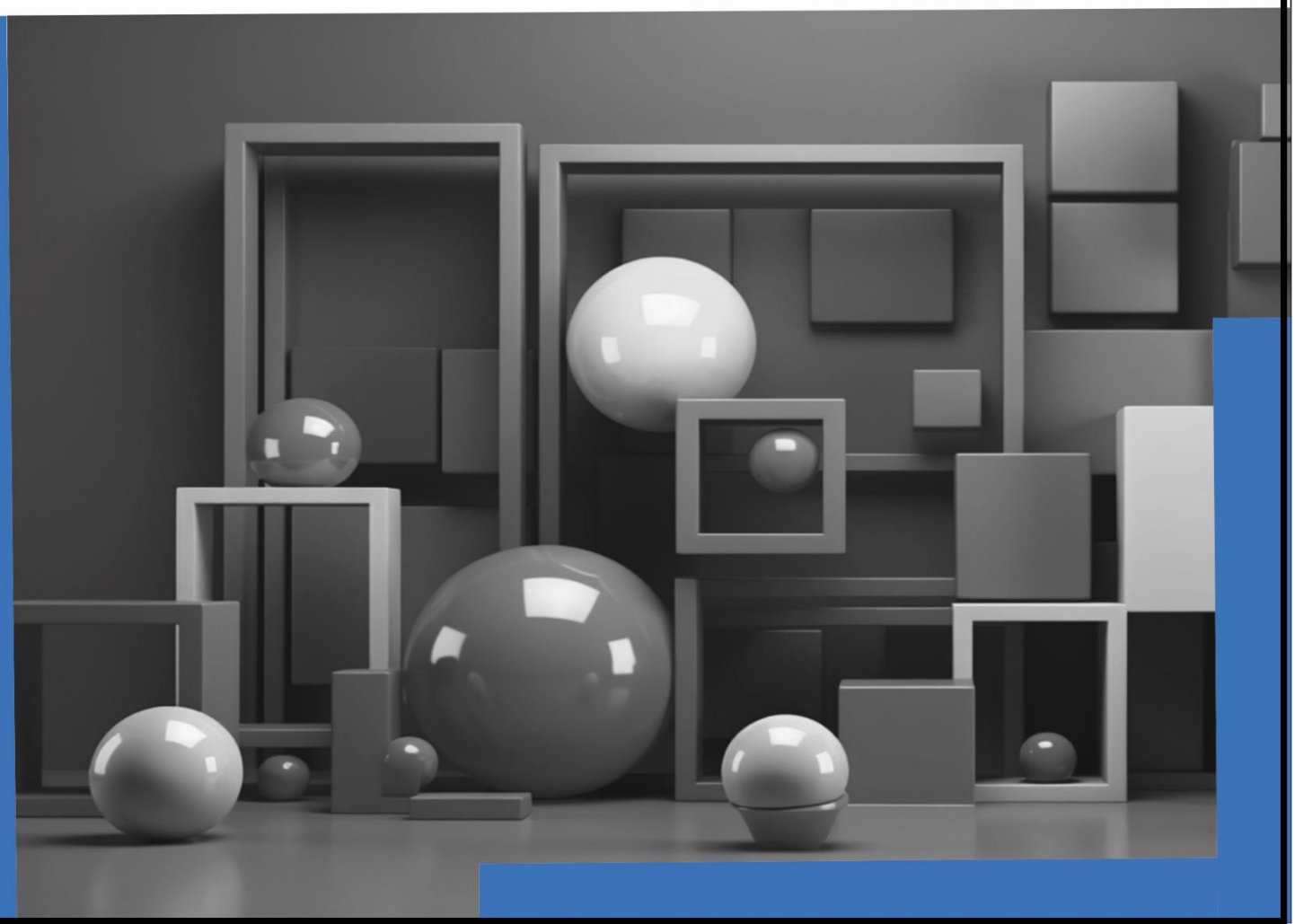
Interactive Computer Graphics: Programming Approach using OpenGL

- Dr. Shivakumar V. Saboji
- Dr. Shivanand V. Manjaragi



INTERACTIVE COMPUTER GRAPHICS: PROGRAMMING APPROACH USING OPENGL

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PREFACE

Computer Graphics is a transformative paradigm that enables scalable, convenient, on-demand access to a shared pool of configurable computing resources for efficiently delivering applications. This book is written as a text book on Computer Graphics using OpenGL for educational programmes at colleges, universities. The typical reader is expected to have completed a couple of courses in programming using traditional high level language at the college-level and is either a senior or a beginning graduate student in the field of science, technology, engineering or mathematics.

We have tried to write a comprehensive book that transfers knowledge through an immersive "hands-on" approach, where the reader is provided the necessary guidance and knowledge to develop working code for real-word Computer Graphics applications. Concurrent development of practical applications that accompanies traditional instructional material within the book further enhances the learning process.

The book is organized into 9 chapters these include topics like: Graphics Primitive Representation, OpenGL, Input-Output Interaction, Geometric Objects and Transformations, 3D Object Viewing, Lighting and Shading, Vertices to Fragments, 3D Object Surface Representation.

Chapter 1: Introduction

Provides overview of Applications of Computer Graphics, Raster Scan Display and Random Scan Display, Objects and Viewers, Imaging Systems, Synthetic Camera Model and Graphics Architecture

Chapter 2: Graphics Primitive Representation

Describes Scan Converting Lines, Midpoint Line Drawing Algorithm, Scan Converting Circle

Chapter 3: OpenGL

Provides an introduction to the use of OpenGL Interface, Graphics Functions, Control Functions, viewing, Primitives and Attributes, Text, Attributes, color, polygons and Recursion, plotting implicit functions.

Chapter 4: Input-Output Interaction

Describe the development of Graphics applications using Input Devices, Logical Devices, Input Modes, Programming Event Driven Input, Animating Interactive Programs, Picking, Building Interactive Models

Chapter 5: Geometric Objects and Transformations

Provides description of Scalars, Points and Vectors, Coordinate Systems and Frames, Frames in OpenGL, Modeling Colored Cube, 2DTransformations, Transformations in Homogeneous Coordinates (3D Transformations), Concatenation of Transformations, OpenGL Transformation Matrices (3D Transformations), Interfaces to Three Dimensional Applications, Quaternion's

Chapter 6: 3D Object Viewing

Provides principles and methodologies of Classical and Computer viewing, Viewing with a Computer, Simple Projections, Projections in OpenGL, Hidden-Surface removal

Chapter 7: Lighting and Shading

Provides description of Light and Matter, Light Sources, The Phong Lighting Model, Computation of Vectors, Polygon shading, Light Sources in OpenGL, Specification of Materials in OpenGL

Chapter 8: Vertices to Fragments

Provides principles and methodologies of Clipping, Line-Segment Clipping, Polygon Clipping, Clipping of Other Primitives, Polygon Rasterization, Hidden Surface removal

Chapter 9: 3D Object Surface Representation

Provides description of 3D object Representation, Quadric Surfaces, Bezier Curves and Surfaces, B-Spline Curve

Abbreviations

Cathode Ray Tube (CRT)

GIMP (GNU Image Manipulation Program)

Massachusetts Institute of Technology (MIT)

VDU (Visual Display Unit)

SAGE (Semi-Automatic Ground Equipment)

Design Augmented by Computers-1 (DAC-1

CAD (Computer-Aided Design)

Jet Propulsion Laboratory (JPL)

VICAR (Video Image Communication and Retrieval)

PARC (Palto Alto Research Center)

World Wide Web Consortium (W3C)

Scalable Vector Graphics (SVG)

openGL Utility Toolkit (GLUT)

Current Transformation Matrix (CTM)

Center of Projection (COP)

Direction of Projectoion (DOP)

View-Reference Point (VRP)

View-Up Vector (VUP)

Bidirectional Reflection Distribution Function (BDRF)

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ABOUT THE AUTHORS

Dr. Shivakumar V. Saboji is a professor in the Computer Science and Engineering department at Basaveshwar Engineering College, Bagalkot, with extensive academic and research expertise. He holds a Ph.D. in Computer Science and Engineering from Vishveshwarya Technological University, with a thesis focused on Vertical Handoff Systems in 4G Wireless Networks. He has 23 years of teaching experience, primarily at Basaveshwar Engineering College, with roles ranging from lecturer to professor. His research interests include communication networks, wireless technologies, cyber attack detection, machine learning, and blockchain. Dr. Saboji has received multiple awards for his contributions to research and reviewing for academic journals and conferences. He is also an IEEE member and a patent holder for a cyber attack detection system in IoT devices. He has successfully led research projects, published numerous papers on wireless networks, and supervised several Ph.D. candidates. He is an active participant in conferences and has been a committee member for various international and national academic events. Dr. Saboji is involved in various workshops and seminars, emphasizing cybersecurity, wireless networks, and blockchain technologies. He has also contributed to academia by organizing multiple workshops and student development programs and has served in several administrative roles, including Head of Department and PG coordinator. Dr. Saboji continues to contribute to the academic community through his research, teaching, and leadership roles.

Dr. Shivanand V. Manjaragi is currently an Associate Professor in the Department of Computer Science and Engineering at Hirasugar Institute of Technology, Nidasoshi, Belgaum, Karnataka, India, with extensive academic and research expertise. He holds a Ph.D. in Computer Science and Engineering from Vishveshwarya Technological University, with a thesis entitled "Secured Vertical Handover System for 5G Wireless Networks." Dr. Manjaragi has 20 years of teaching experience in Engineering Education and has held several positions, including IT Head, Head of Department, Associate Professor, Assistant Professor, Senior Lecturer and Lecturer. Blockchain, Machine learning, Deep learning, Cyber security, Wireless networks, and Computer networks are some of his areas of interest in research. In addition, he has been an Indian Society for Technical Education (ISTE) lifetime member. Dr. Manjaragi has guided numerous student projects sponsored by various government agencies and has published many research papers in domains such as Computer Networks, Wireless Networks, Cyber Security, Deep Learning, and Blockchain. He has served as a reviewer for many international journals and conferences and has actively participated as a session chair in conferences. In addition to his teaching and research activities, Dr. Manjaragi has contributed to academia by organizing multiple workshops and student development programs.

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