**ABSTRACT**

In computer science, client-server is a software architecture model consisting of two parts, client systems and server systems, both communicating over a computer network or on the same computer. The client-server model is a distributed application structure that partitions tasks or workloads between the providers of a resource or service, called servers, and service requesters, called clients. Often clients and servers communicate over a computer network on separate hardware, but both client and server may reside in the same system. The client process always initiates a connection to the server, while the server process always waits for requests from any client. A server host runs one or more server programs which share their resources with clients. A client does not share any of its resources, but requests a server's content or service function. Clients therefore initiate communication sessions with servers which await incoming requests. The client and server communicate with each other through a well-known application protocol.

**Project to Program Outcomes (PO) Mapping**

**Project Name:** Client Server Simulation Using OpenGL

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| ✓ | ✓ | ✓ | ✓ | ✓ |  |  | ✓ | ✓ | ✓ | ✓ | ✓ |

|  |  |
| --- | --- |
| **Program outcomes (POs):** | |
| **PO1** | **Engineering knowledge:** Apply the knowledge of Mathematics, Science, Engineering fundamentals and an engineering specialization to the solution of complex engineering problems |
| **PO2** | **Problem analysis:** Identify, formulate, review research literature, and analyse complex Engineering problems reaching substantiated conclusions using first principles of mathematics, Natural sciences and engineering sciences |
| **PO3** | **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. |
| **PO4** | **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the Information to provide valid conclusions |
| **PO5** | **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations. |
| **PO6** | **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice. |
| **PO7** | **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for Sustainable development |
| **PO8** | **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. |
| **PO9** | **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings |
| **PO10** | **Communication:** Communicate effectively on complex engineering activities with the engineering Community and with society at large, such as, being able to comprehend and write effective reports And design documentation, make effective presentations, and give and receive clear instructions. |
| **PO11** | **Project management and finance:** Demonstrate knowledge and understanding of the Engineering and management principles and apply these to one’s own work, as a member and Leader in a team, to manage projects and in multidisciplinary environments. |
| **PO12** | **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. |

**Project to Program Specific Outcomes (PSO) Mapping**

**Project Name:** Client Server Simulation Using OpenGL

|  |  |
| --- | --- |
| **PSO1** | **PSO2** |
| ✓ | ✓ |

|  |  |
| --- | --- |
| **Program Specific Outcomes (PSOs):** | |
| **PSO1** | Analyze the problem and identify computing requirements appropriate to its solution. |
| **PSO2** | Apply design and development principles in the construction of software systems of varying complexity. |

**CHAPTER 1**

* 1. **BRIEF INTRODUCTION :**

In today’s era of the internet majority of the communications happens through the client-server architecture model. All online transactions such as browsing the web, shopping on e-commerce portals, online banking transactions, etc are made possible through communication between the client i.e. the user of a service and the server. This process of communication is not as simple as explained above.

Clients and servers exchange messages in a request–response messaging pattern. The client initiates a request to the server and the server returns a response. This exchange of messages is an example of inter-process communication. To start the actual communication between the client and server, first a connection has to be established between the client and server through an interface called socket. Once the connection is set up, the client and server exchange messages through this socket.  To communicate, the computers must have a common language, and they must follow rules so that both the client and the server know what to expect. The language and rules of communication are defined in a communications protocol.

The exchange of messages between the client and server is in the form of data packets . Bytes are grouped together to form a data packet. Apart from the actual message the data packets also contain additional information such as source and destination address, protocol and its version, error control information, etc.

**1.2 MOTIVATION :**

Simulation of any process helps in better understanding of it. This project will demonstrate the internal working of a client-server architecture model. It would help in visualizing how connection between a client and server is established. This system can be used for educational purposes to teach and explain the working of client and server and network programming.

* 1. **SCOPE :**

Simulation of any process helps in better understanding of it. This project will demonstrate the internal working of a client-server architecture model. It would help in visualizing how connection between a client and server is established.

The existing system of displaying a simulated system of client server simulations has always been flawed because of its inability to display a simulated GUI. It has always been unable to convey a convincing display about the packet transfer and the receiving party and also to know where the packets and data is being sent to the server.

Our system covers the existing in the way that only the necessary and essential transfers are noted and also the actual details of the packets being sent are noted. The details about what is in the packets is not noted down and only the simulations of the working packets is clearly shown. This will help a person understand what is happening in a network without understanding the technical details in the network. This system can be used for educational purposes to teach and explain the working of client and server and network programming.

* 1. **STATEMENT OF PROBLEM:**

The aim of the simulation is to provide a graphical interface to a user to show how exactly client server simulation in a network happens. This should allow the user to understand how exactly communication happens between client server in a network. So the user should be able see how the commands are sent from client to server and how the responses happen. The user should understand how the packets in a network travel from the client to the server. The various functions such as retrieve, store and list should also be visualised in real time.

**1.5 LIMITATION OF PROBLEM:**

Our system provides insight into data being sent across client and server and how exactly communication happens. While the packet transfer to the different components of the client and server is shown, this does not show what exactly is contained inside the packets and how the packets are routed. It does not explain how the data is encapsulated inside a data packet or what exactly the commands are and the internet protocol used is also left unexplained for now.

**CHAPTER 2**

**LITERATURE SURVEY**

**2.1 Computer Graphics**

Graphics provides one of the most natural means of communicating within a computer, since our highly developed 2D and 3D pattern-recognition abilities allow us to perceive process pictorial data rapidly and effectively. Interactive computer graphics is the most important means of producing pictures since the invention of photography and television. It has the added advantage that, with the computer, we can make pictures not only of concrete real world objects but also of abstract, synthetic objects, such as mathematical surfaces and of data that have no inherent geometry, such as survey results. Computer graphics started with the display of data on hardcopy plotters and cathode ray tube screens soon after the introduction of computers themselves. It has grown to include the creation, storage, and manipulation of models and images of objects. These models come from a diverse and expanding set of fields, and include physical, mathematical, engineering, architectural, and even conceptual structures, natural phenomena, and so on. Computer graphics today is largely interactive. The user controls the contents, structure, and appearance of the objects and of their displayed images by using input devices, such as keyboard, mouse, or touch-screen. Due to close relationships between the input devices and the display, the handling of such devices is included in the study of computer graphics. The advantages of the interactive graphics are many in number. Graphics provides one of the most natural means of communicating with a computer, since our highly developed 2D and 3D patter-recognition abilities allow us to perceive and process data rapidly and efficiently. In many design, implementation, and construction processes today, the information pictures can give is virtually indispensable. Scientific visualization became an important field in the 1980s when the scientists and engineers realized that they could not interpret the prodigious quantities of data produced in supercomputer runs without summarizing the data and highlighting trends and phenomena in various kinds of graphical representations.

**2.2 OpenGL Interface**

OpenGL is an application program interface (API) offering various functions to implement primitives, models and images. This offers functions to create and manipulate render lighting, coloring, viewing the models. OpenGL offers different coordinate system and frames. OpenGL offers translation, rotation and scaling of objects. Most of our applications will be designed to access OpenGL directly through functions in three libraries. They are:

1. Main GL: Library has names that begin with the letter gl and are stored in a library usually referred to as GL.

2. OpenGL Utility Library (GLU): This library uses only GL functions but contains code for creating common objects and simplifying viewing.

3. OpenGL Utility Toolkit (GLUT): This provides the minimum functionality that should be accepted in any modern windowing system.

**2.3 OpenGL Overview**

* OpenGL (Open Graphics Library) is the interface between a graphic program and graphics hardware. It is streamlined. In other words, it provides low-level functionality. For example, all objects are built from points, lines and convex polygons. Higher level objects like cubes are implemented as six four-sided polygons.
* OpenGL supports features like 3-dimensions, lighting, anti-aliasing, shadows, textures, depth effects, etc.
* It is system-independent. It does not assume anything about hardware or operating system and is only concerned with efficiently rendering mathematically described scenes. As a result, it does not provide any windowing capabilities.
* It is a state machine. At any moment during the execution of a program there is acurrent model transformation.
* It is a rendering pipeline. The rendering pipeline consists of the following steps:
* Defines objects mathematically.
* Arranges objects in space relative to a viewpoint.
* Calculates the color of the objects.
* Rasterizes the objects.

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OpenGL (open graphics library) is a standard specification defining a cross language cross platform API for writing applications that produce 2D and 3D computer graphics. OpenGL was developed by silicon graphics Inc. (SGI) in 1992 and is widely used in CAD, virtual reality, scientific visualization, information visualization and flight simulation. It is also used in video games.

OpenGL serves two main purpose:

* To hide the complexities of interfacing with different 3D accelerators, by presenting programmer with a single, uniform API
* To hide the differing capabilities of hardware platforms, by requiring that all Implementations support the full openGL, feature set.

OpenGL has historically been influential on the development of 3D accelerator, promoting a base level of functionality that is now common in consumer level hardware:

* Rasterized points, lines and polygons are basic primitives.
* A transform and lighting pipeline.
* Z buffering.
* Texture Mapping, Alpha, Blending.

**2.4 Client Server Architecture**

Clients and servers exchange messages in a [request–response](https://en.wikipedia.org/wiki/Request%E2%80%93response) [messaging pattern](https://en.wikipedia.org/wiki/Messaging_pattern). The client sends a request, and the server returns a response. This exchange of messages is an example of [inter-process communication](https://en.wikipedia.org/wiki/Inter-process_communication). To communicate, the computers must have a common language, and they must follow rules so that both the client and the server know what to expect. The language and rules of communication are defined in a [communications protocol](https://en.wikipedia.org/wiki/Communications_protocol). All client-server protocols operate in the [application layer](https://en.wikipedia.org/wiki/Application_layer). The application layer protocol defines the basic patterns of the dialogue. To formalize the data exchange even further, the server may implement an [application programming interface](https://en.wikipedia.org/wiki/Application_programming_interface) (API). The API is an [abstraction layer](https://en.wikipedia.org/wiki/Abstraction_layer) for accessing a service. By restricting communication to a specific [content format](https://en.wikipedia.org/wiki/Content_format), it facilitates [parsing](https://en.wikipedia.org/wiki/Parsing). By abstracting access, it facilitates cross-platform data exchange.

A server may receive requests from many distinct clients in a short period of time. A computer can only perform a limited number of [tasks](https://en.wikipedia.org/wiki/Task_(computing)) at any moment, and relies on a [scheduling](https://en.wikipedia.org/wiki/Scheduling_(computing)) system to prioritize incoming requests from clients to accommodate them. To prevent abuse and maximize [availability](https://en.wikipedia.org/wiki/Uptime), server software may limit the availability to clients. [Denial of service attacks](https://en.wikipedia.org/wiki/Denial_of_service_attack) are designed to exploit a server's obligation to process requests by overloading it with excessive request rates.

The client–server model does not dictate that server-hosts must have more resources than client-hosts. Rather, it enables any general-purpose computer to extend its capabilities by using the shared resources of other hosts. [Centralized computing](https://en.wikipedia.org/wiki/Centralized_computing), however, specifically allocates a large amount of resources to a small number of computers. The more computation is offloaded from client-hosts to the central computers, the simpler the client-hosts can be.

**CHAPTER 4**

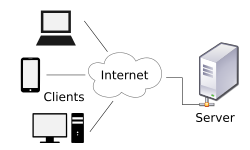
**SYSTEM ANALYSIS**

**4.1 CLIENT SERVER COMMUNICATION**

In general, a service is an [abstraction](https://en.wikipedia.org/wiki/Abstraction_(computer_science)) of computer resources and a client does not have to be [concerned](https://en.wikipedia.org/wiki/Concern_(computer_science)) with how the server performs while fulfilling the request and delivering the response. The client only has to understand the response based on the well-known application protocol, i.e. the content and the formatting of the data for the requested service.

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**Fig 1 – Client Server Model**

When a [bank](https://en.wikipedia.org/wiki/Bank) customer accesses [online banking](https://en.wikipedia.org/wiki/Online_banking) services with a [web browser](https://en.wikipedia.org/wiki/Web_browser) (the client), the client initiates a request to the bank's web server. The customer's [login](https://en.wikipedia.org/wiki/Login) credentials may be stored in a [database](https://en.wikipedia.org/wiki/Database), and the web server accesses the [database server](https://en.wikipedia.org/wiki/Database_server) as a client. An [application server](https://en.wikipedia.org/wiki/Application_server) interprets the returned data by applying the bank's [business logic](https://en.wikipedia.org/wiki/Business_logic), and provides the [output](https://en.wikipedia.org/wiki/Input/output) to the web server. Finally, the web server returns the result to the client web browser for display.

In each step of this sequence of client–server message exchanges, a computer processes a request and returns data. This is the request-response messaging pattern. When all the requests are met, the sequence is complete and the web browser presents the data to the customer.

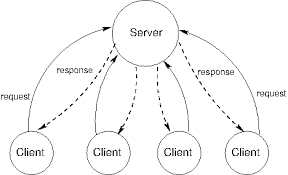
This example illustrates a [design pattern](https://en.wikipedia.org/wiki/Design_pattern) applicable to the client–server model: [separation of concerns](https://en.wikipedia.org/wiki/Separation_of_concerns).

The client-server characteristic describes the relationship of cooperating programs in an application. The server component provides a function or service to one or many clients, which initiate requests for such services. Servers are classified by the services they provide. For example, a [web server](https://en.wikipedia.org/wiki/Web_server) serves [web pages](https://en.wikipedia.org/wiki/Web_page) and a [file server](https://en.wikipedia.org/wiki/File_server) serves [computer files](https://en.wikipedia.org/wiki/Computer_file). A shared resource may be any of the server computer's software and electronic components, from [programs](https://en.wikipedia.org/wiki/Computer_program) and [data](https://en.wikipedia.org/wiki/Data_(computing)) to [processors](https://en.wikipedia.org/wiki/Microprocessor) and [storage devices](https://en.wikipedia.org/wiki/Data_storage_device). The sharing of resources of a server constitutes a service.

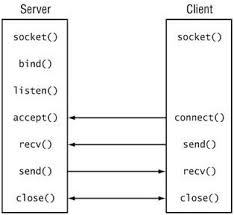
**CHAPTER 5**

**SYSTEM DESIGN**

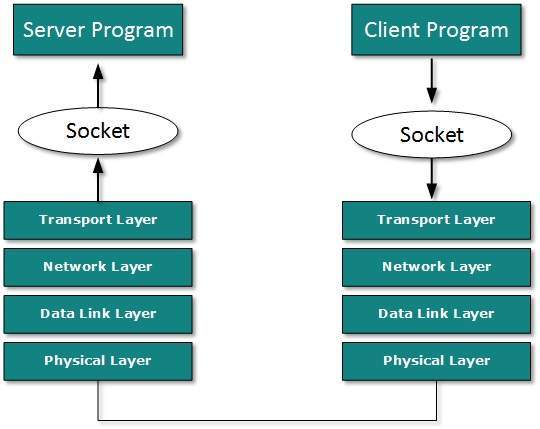
**5.1 Architectural design**

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**5.2 Component design**

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**5.3 Behavioural design**

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