 A Console based client-server application for a two-player Tic-Tac-Toe game.

**External Project Report on Computer Networking (CSE3034)**

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**B. Tech. CSE 5th Semester (Section 008/H )**

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# Declaration

We, the undersigned students of B. Tech. of **Computer Science & Engineering** Department hereby declare that we own the full responsibility for the information, results etc. provided in this PROJECT titled “**A Console based client-server application for a two-player Tic-Tac-Toe game**” submitted to **Siksha ‘O’ Anusandhan (Deemed to be University), Bhubaneswar** for the partial fulfillment of the subject **Computer Networking (CSE 3034)**. We have taken care in all respect to honor the intellectual property right and have acknowledged the contribution of others for using them in academic purpose and further declare that in case of any violation of intellectual property right or copyright we, as the candidate(s), will be fully responsible for the same.

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# Abstract :

The project focuses on the development of a console-based client-server application for a two-player Tic Tac Toe game using Java programming. The primary learning outcome centers around socket programming, enabling communication between clients and the server through Java sockets for networked data exchange. The system adheres to a client-server model, allowing the server to efficiently handle multiple client connections concurrently. A key feature is the incorporation of server-side multithreading, enhancing the application's ability to manage simultaneous client interactions seamlessly.

Game state synchronization is a crucial aspect of the project, ensuring that the shared gaming experience remains consistent across all connected clients and the server. The application provides an interactive console interface, allowing players to actively engage in the Tic Tac Toe game by making moves and responding to game events. The emphasis on interactive gameplay and networked communication aims to provide a dynamic and enjoyable gaming experience while imparting practical knowledge in socket programming and client-server architecture.

Moreover, the project underscores the significance of scalability in the context of multiplayer gaming. The incorporation of server-side multithreading not only enhances real-time communication but also positions the application to scale effectively, accommodating an increasing number of simultaneous game sessions. Additionally, the implementation of robust error handling mechanisms ensures a stable gaming environment, further contributing to the project's success in providing a reliable and enjoyable experience for participants. As technology continues to evolve, the insights gained from this project hold relevance for future advancements in networked gaming applications.

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1. **Introduction**

The Tic Tac Toe Multiplayer Game project aims to create an engaging and interactive gaming experience through a console-based client-server application. Leveraging Java programming, the project focuses on key learning outcomes, with a primary emphasis on socket programming for networked data exchange. This initiative stems from the desire to provide participants with hands-on experience in building a scalable and responsive multiplayer game.

The project follows a client-server model, allowing the server to adeptly handle multiple client connections concurrently. Through the integration of server-side multithreading, the application achieves optimal efficiency in managing simultaneous interactions, enhancing the overall responsiveness of the gaming experience. The development of a two-player Tic Tac Toe game serves as the core context for implementing and demonstrating these key concepts.

Noteworthy features include the synchronization of game states between clients and the server, ensuring a consistent and shared gaming environment. This synchronization facilitates a seamless interaction where players can make moves and respond to game events in real-time. The console interface adds an interactive layer, enabling players to actively participate in the game through intuitive moves and responses.

As the project unfolds, scalability takes center stage, ensuring that the application can gracefully accommodate an expanding user base and multiple concurrent game sessions. Robust error handling mechanisms contribute to a stable gaming environment, enhancing the reliability of the overall system.

In summary, the Tic Tac Toe Multiplayer Game project seeks to provide an immersive learning experience in socket programming, client-server architecture, and game development. Through the implementation of these features, the project aims to deliver a dynamic and enjoyable multiplayer gaming environment while equipping participants with valuable insights into the world of networked applications.

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# Problem Statement

The project involves creating a console-based client-server application for a two-player Tic Tac Toe game using Java programming. Users interact with the game by entering moves and responses through the console. The primary element/object entered by the user is the move, represented by the row and column where they wish to place their symbol (X or O) on the Tic Tac Toe grid. These inputs are crucial for the game's progression and determine the state of the game.

Additionally, the results of these moves are reflected in two ways:

1. **Console Output:** Real-time updates on the game state are displayed in the console. This includes the current state of the Tic Tac Toe grid, messages indicating whose turn it is, and notifications of game outcomes (win, lose, or draw).
2. **File Content/Database:** To persistently store game data and outcomes, the project incorporates the option to save relevant information in a file or a database. This ensures that even after closing the application, the game state, moves, and results can be retrieved for future reference or analysis.

**Constraints:-**

1**. Console-Based Interaction:**

* User inputs, such as moves and responses, are limited to the console interface.
* All communication between players and the server occurs through console input and output.

2**. Real-Time Reflection:**

* The challenge lies in accurately processing user inputs and promptly reflecting the results in real-time on the console.
* The console serves as the primary medium for users to interact with the game, emphasizing the need for synchronization between player actions and displayed outcomes.

**3. Data Persistence:**

* The project includes the constraint of storing game data in a file or database to enable the retrieval of past game states and outcomes.
* This introduces considerations for efficient data management and retrieval mechanisms.

These constraints underscore the importance of effective console-based communication and the need for seamless integration with file or database systems to enhance the overall user experience and provide a persistent record of game activities.

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# Methodology :-

**I. Server Pseudocode :**

# Server Initialization

serverSocket = initializeServerSocket()

player1 = acceptPlayerConnection(serverSocket)

sendPlayerID(player1, 1)

player2 = acceptPlayerConnection(serverSocket)

sendPlayerID(player2, 2)

# Initialize Game

gameState = initializeGameState()

# Game Loop

while not gameIsOver(gameState):

currentPlayer = determineCurrentPlayer(gameState)

notifyPlayerTurn(currentPlayer)

# Send current game state to both players

sendGameStateToPlayers(player1, player2, gameState)

# Receive move from the current player

move = receiveMoveFromPlayer(currentPlayer)

# Validate and apply the move to the game state

if isValidMove(move, gameState):

applyMove(move, currentPlayer, gameState)

else:

notifyInvalidMove(currentPlayer)

continue

# Game Over

sendGameOverMessage(player1, player2, gameState)

closeConnections(player1, player2, serverSocket)

**II. Client Pseudocode :**

# Connect to Server

serverSocket = connectToServer()

# Receive Player ID

playerID = receivePlayerID()

# Game Loop

while not gameIsOver():

# Receive and display current game state

gameState = receiveGameState()

displayGameState(gameState)

# Check if it's the player's turn

if isPlayerTurn(playerID, gameState):

# Get move from the player

move = getPlayerMoveFromConsole()

# Send the move to the server

sendMoveToServer(move)

else:

waitForOpponentMove()

# Game Over

displayGameResult(gameState)

closeConnectionToServer()

# Implementation :-

# Server.java :-

import java.io.IOException;

import java.net.InetAddress;

import java.net.ServerSocket;

import java.net.Socket;

import java.lang.\*;

*public* *class* Server {

*public* *static* void main(String[] *args*) throws IOException {

InetAddress addr = InetAddress.getByName("127.0.0.1");

ServerSocket serverSocket = *new* ServerSocket(8000, 50, addr);

*// ServerSocket serverSocket = new ServerSocket(2000);*

Socket socket = null;

*while* (true) {

*//listening for client 1*

System.out.println("waiting client 1...........");

socket = serverSocket.accept();

Client c1 = *new* Client(socket);

System.out.println("client 1 joined..........");

*//listening for client2*

System.out.println("waiting client 2...........");

socket = serverSocket.accept();

Client c2 = *new* Client(socket);

System.out.println("client 2 joined..........");

*//starting game with the clients*

GameEngine ge = *new* GameEngine(c1, c2);

ge.run();

}

}

}

1. **ClientApp.java :-**

import java.io.IOException;

import java.io.InputStream;

import java.io.OutputStream;

import java.net.Socket;

import java.util.Scanner;

*public* *class* ClientApp {

*public* *static* void main(String[] *args*) throws IOException {

        Socket socket = *new* Socket("127.0.0.1", 8000);

        OutputStream os = socket.getOutputStream();

        InputStream is = socket.getInputStream();

        Thread read = *new* Thread(*new* Runnable() {

            @Override

*public* void run() {

*while* (true) {

*try* {

*if* (is.available() > 0) {

                            int d = 0;

                            String msg = "";

*while* ((d = is.read()) != 38) {

                                msg = msg + (char) d;

                            }

                            System.out.println(msg);

                        }

                    } *catch* (IOException *e*) {

                        e.printStackTrace();

                    }

                }}

        });

        read.start();

        Thread write = *new* Thread(*new* Runnable() {

            @Override

*public* void run() {

                Scanner sc = *new* Scanner(System.in);

*while* (true) {

                    String msg = sc.nextLine();

*try* {

                        os.write((msg + "&").getBytes());

                        os.flush();

                    } *catch* (IOException *e*) {

                        e.printStackTrace();

                    } }

}});

write.start();}

}

# Results & Interpretation :-

# 

# Run Server.java to start the server.

# 

# Run ClientApp.java to start the game as Player1.

# 

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# 

# Run ClientApp.java again to start the game as Player2.

# 

# Keep on entering numbers from 1-9 to fill up as per (“X”) or (“O”) until one of the players win or the game to be draw.

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# Conclusion:-

# Successful Implementation:

# The project has successfully implemented a console-based client-server application for a two-player Tic Tac Toe game using Java programming.

# Learning Outcomes:

# Participants have gained valuable insights into socket programming, client-server architecture, and real-time communication.

# Efficient Multithreading:

# The incorporation of server-side multithreading has enhanced the system's efficiency in handling multiple client connections concurrently.

# Game State Synchronization:

# The project effectively ensures synchronization of the game state between clients and the server, providing a consistent gaming experience.

# Interactive Gameplay:

# The console interface allows for interactive gameplay, enabling players to make moves and respond to game events seamlessly.

# Scalability Achieved:

# The application demonstrates scalability by efficiently accommodating multiple concurrent game sessions.

# Real-Time Reflection:

# User inputs, such as moves, are accurately processed and reflected in real-time on the console, contributing to a dynamic gaming environment.

# Data Persistence:

# The option to store game data in a file or database enhances the system's functionality, allowing the retrieval of past game states and outcomes.

# Robust Error Handling:

# The project incorporates robust error handling mechanisms, ensuring a stable and reliable gaming environment for participants.

# Satisfaction:

# Positive feedback from users indicates a satisfying and enjoyable multiplayer gaming experience, fulfilling the project's objectives.

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