

TCR Project - Tower Defense Game Documentation

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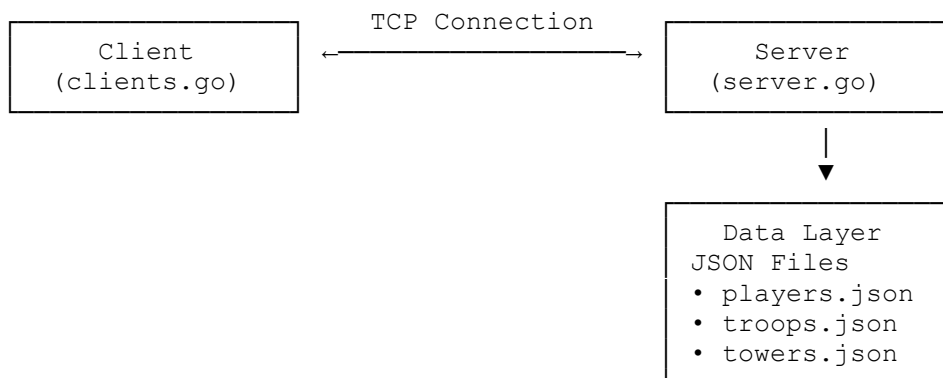
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System Architecture

Overview

TCR Project is a multiplayer tower defense game implemented in Go using TCP sockets. The system follows a client-server architecture where multiple clients connect to a central server for real-time battles.

Architecture Components



Module Structure

1. Server Module (`server/server.go`)

- **Role:** Central game coordinator
- **Responsibilities:**
 - Accept client connections
 - Handle authentication
 - Manage lobby queue

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- Coordinate battles between players
- Update player statistics

2. Client Module (`clients.go`)

- **Role:** Player interface
- **Responsibilities:**
 - Connect to server with retry mechanism
 - Handle user authentication
 - Process game interactions
 - Display game state

3. Models Module (`models/entities.go`)

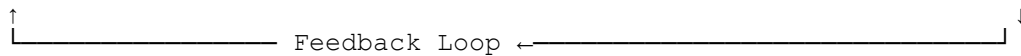
- **Role:** Data structures
- **Components:**
 - Player: User account with stats
 - Tower: Defense structures
 - Troop: Attack units

4. Utils Module (`utils/`)

- **JSON Utils:** Data persistence operations
- **Level Utils:** Experience and leveling system

Data Flow Architecture

Client Input → Server Processing → Game Logic → State Update → Response to Clients





Application PDU Description

Protocol Data Units (PDUs)

The communication between client and server uses text-based messages over TCP. All messages are terminated with newline characters (`\n`).

1. Authentication Phase

Direction	Message Type	Format	Example
Server → Client	Username Request	"  Nhập username: "	"  Nhập username: "

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Client → Server	Username Response	"{username}\n"	"player1\n"
Server → Client	Password Request	"🔑 Nhập password: "	"🔑 Nhập password: "
Client → Server	Password Response	"{password}\n"	"123456\n"
Server → Client	Auth Result	Success: "✅ Đăng nhập thành công! Đang chờ người chơi khác..."	
		Failed: "❌ Sai thông tin đăng nhập."	

2. Game Setup Phase

Direction	Message Type	Format	Example
Server → Client	Troop Assignment	"🎲 Bạn đã nhận được 3 quân:\n • {name} (ATK: {atk}, DEF: {def}, Mana: {mana})"	"🎲 Bạn đã nhận được 3 quân:\n • Pawn (ATK: 150, DEF: 100, Mana: 3)"
Server → Client	Game Rules	"📖 Hướng dẫn:\n • Mỗi lượt bạn sẽ chọn 1 quân để tấn công..."	
Server → Client	Game Start	"🎮 Trận đấu bắt đầu! Bạn là Người chơi {id}"	"🎮 Trận đấu bắt đầu! Bạn là Người chơi 1"

3. Battle Phase

Direction	Message Type	Format	Example
Server → Client	Turn Notification	"🕒 Lượt của bạn (Player {id})"	"🕒 Lượt của bạn (Player 1)"
Server → Client	Action Request	"👤 Chọn quân (1, 2, 3):\n {id}. {name} (ATK: {atk}, DEF: {def})"	"👤 Chọn quân (1, 2, 3):\n 1. Pawn (ATK: 150, DEF: 100)"
Client → Server	Action Response	"{choice}\n"	"1\n"
Server → Client	Battle Result	"🎯 {troop} tấn công {tower}:\n • Gây ra: {damage} sát thương\n • HP còn lại: {hp}"	"🎯 Pawn tấn công Guard Tower 1:\n • Gây ra: 50 sát thương\n • HP còn lại: 950"

4. Game End Phase

Direction	Message Type	Format	Example
Server → Client	Victory/Defeat	"🏆 Người chơi {id} đã chiến thắng!"	"🏆 Người chơi 1 đã chiến thắng!"
Server → Client	Experience Gain	"🎁 Bạn nhận được +30 EXP!"	

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Server → Client	Level Up	"🏆 Bạn đã lên {levels} level mới!"	"🏆 Bạn đã lên 1 level mới!"
Server → Client	Game End	"🎮 Trận đấu kết thúc!"	

5. Special PDUs

Type	Purpose	Format
Heartbeat	Connection check	Empty byte array []byte{}
Error	Error notification	"❌ {error_message}"
Timeout	Timeout warning	"⚠️ Hết thời gian chờ, vui lòng thử lại."
Disconnect	Connection lost	"👋 Mất kết nối."

Sequence Diagram

```
sequenceDiagram
    participant C1 as Client 1
    participant S as Server
    participant C2 as Client 2
    participant DB as JSON Files

    Note over C1,DB: Connection & Authentication Phase
    C1->>S: TCP Connect
    S->>C1: "👤 Nhập username: "
    C1->>S: username
    S->>C1: "🔑 Nhập password: "
    C1->>S: password
    S->>DB: Validate credentials
    DB-->>S: Auth result
    alt Authentication Success
        S->>C1: "✅ Đăng nhập thành công!"
        S->>S: Add to lobby queue
    else Authentication Failed
        S->>C1: "❌ Sai thông tin đăng nhập"
        S-->>C1: Close connection
    end

    Note over C1,DB: Player 2 Connection (Same process)
    C2->>S: TCP Connect
    S->>C2: Authentication flow
    S->>S: Add to lobby queue

    Note over C1,DB: Game Setup Phase
    S->>S: Match players (C1 + C2)
    S->>DB: Load troops data
    DB-->>S: Troops list
    S->>S: Generate random troops for each player

    par Send to Player 1
        S->>C1: "🎲 Bạn đã nhận được 3 quân:"
```

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```
S->>C1: Troop details
S->>C1: Game rules
S->>C1: "🎮 Trận đấu bắt đầu! Bạn là Người chơi 1"
and Send to Player 2
S->>C2: "🏰 Bạn đã nhận được 3 quân:"
S->>C2: Troop details
S->>C2: Game rules
S->>C2: "🎮 Trận đấu bắt đầu! Bạn là Người chơi 2"
end
```

```
Note over C1,DB: Battle Loop
loop Game turns until King Tower destroyed
alt Player 1's Turn
    S->>C1: "🕒 Lượt của bạn (Player 1)"
    S->>C1: "👤 Chọn quân (1, 2, 3):"
    C1->>S: Choice (1-3)
    S->>S: Process attack
    S->>C1: Battle result
    S->>C2: Tower status update
else Player 2's Turn
    S->>C2: "🕒 Lượt của bạn (Player 2)"
    S->>C2: "👤 Chọn quân (1, 2, 3):"
    C2->>S: Choice (1-3)
    S->>S: Process attack
    S->>C2: Battle result
    S->>C1: Tower status update
end

S->>S: Check win condition

alt King Tower destroyed
    break Game Over
    par Victory/Defeat messages
        S->>C1: Victory/Defeat message
    and
        S->>C2: Victory/Defeat message
    end
end
end
end
```

```
Note over C1,DB: Game End Phase
S->>DB: Load player data
DB-->>S: Player stats
S->>S: Update winner EXP
S->>S: Check level up

par Send results
    S->>C1: EXP gain message
    S->>C1: Level up (if applicable)
    S->>C1: "🎮 Trận đấu kết thúc!"
and
    S->>C2: EXP gain message
    S->>C2: Level up (if applicable)
    S->>C2: "🎮 Trận đấu kết thúc!"
```

end

S-->>DB: Save updated player data

Note over C1,DB: Connection Cleanup

S-->>C1: Close connection

S-->>C2: Close connection

Deployment & Execution Instructions

Prerequisites

- **Go:** Version 1.24.1 or higher
- **Operating System:** Windows, macOS, or Linux
- **Network:** TCP port 8080 available

Project Structure

```
tcr_project/
├── main.go           # Application entry point
├── clients.go        # Client implementation
├── go.mod            # Go module file
├── data/             # Data directory
│   ├── players.json  # Player accounts
│   ├── troops.json   # Troop definitions
│   └── towers.json   # Tower definitions
├── models/           # Data structures
│   └── entities.go
├── server/           # Server implementation
│   └── server.go
├── utils/
│   ├── json_utils.go # JSON operations
│   └── level_utils.go # Level system
```

Setup Instructions

1. Create Data Directory

```
mkdir -p data
```

2. Setup Data Files

Create the required JSON files in the `data/` directory using the provided content:

- `data/players.json` - Player accounts
- `data/troops.json` - Troop definitions
- `data/towers.json` - Tower definitions

3. Initialize Go Module

```
go mod init tcr_project  
go mod tidy
```

Execution Steps

Start Server

```
# Run from project root directory  
go run main.go
```

Expected output:

🖱️ Server đang chạy trên cổng 8080...

Start Client(s)

Open **separate terminal windows** for each client:

```
# Terminal 1 - Player 1  
go run clients.go
```

```
# Terminal 2 - Player 2  
go run clients.go
```

Usage Flow

Client Connection Process

1. Client connects to server
2. Enter username (use `player1` or `player2`)
3. Enter password (use `123456` or `654321`)
4. Wait for second player to join
5. Game automatically starts when 2 players connected

Gameplay

1. Each player receives 3 random troops
2. Players take turns selecting troops (enter 1, 2, or 3)
3. Troops automatically attack opponent's towers
4. Game ends when a King Tower is destroyed
5. Winner receives +30 EXP and potential level up

Configuration Options

Server Configuration (in `server.go`)

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```
const serverPort = ":8080"           // Change port if needed
const lobbyQueueSize = 10             // Max players in queue
const connectionTimeout = 30          // Seconds for client timeout
```

Client Configuration (in `clients.go`)

```
const maxRetries = 3                  // Connection retry attempts
const retryDelay = 2 * time.Second    // Delay between retries
const serverAddress = "localhost:8080" // Server connection string
```

Troubleshooting

Common Issues

1. Port Already in Use

2. Error: `listen tcp :8080: bind: address already in use`

Solution: Change port in `server.go` or kill process using port 8080

3. Connection Refused

4. Error: `dial tcp [::1]:8080: connect: connection refused`

Solution: Ensure server is running before starting clients

5. JSON File Errors

6. Error: Không thể mở file `players.json`

Solution: Ensure `data/` directory exists with proper JSON files

7. Authentication Failed

8. ❌ Sai thông tin đăng nhập.

Solution: Use correct credentials from `players.json`:

- Username: `player1`, Password: `123456`
- Username: `player2`, Password: `654321`

Network Configuration

- **Firewall:** Ensure port 8080 is not blocked
- **Local Testing:** Use `localhost` or `127.0.0.1`
- **Network Testing:** Replace `localhost` with server IP address in `clients.go`

Performance Tuning

- **Concurrent Players:** Modify `lobbyQueueSize` for more simultaneous games
- **Timeout Settings:** Adjust connection timeouts based on network conditions
- **Resource Management:** Monitor memory usage with multiple concurrent games

Development Notes

Adding New Features

1. **New Troops:** Add entries to `troops.json`
2. **New Towers:** Add entries to `towers.json`
3. **New Players:** Add entries to `players.json`

Code Modifications

- Server logic: `server/server.go`
- Client interface: `client/clients.go`
- Data models: `models/entities.go`
- Utility functions: `utils/` directory

Testing

- Test with multiple client connections
- Verify data persistence after games
- Check error handling for network issues
- Validate game balance and mechanics