Four in a row online

Project of Foundation of Cybersecurity

Barsanti Nicola, Tumminelli Gianluca

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Contents

1 Requirement Analysis

This paper will document the development of the game *Four in a row online*. The application is a multiplayer online game accessed by a graphic interface where each user must be authenticated before access the application and his communication must be confidential and secure. When logged the user could choose another player, start a match and then they could talk each other and play the game. The application will have a score table where there will be printed general statistics about all the users of the application.

1.1 Specification Document

- The user will access the application through a GUI
- The user will access the application remotely
- The user could register a new account
- The user messages must be secure,confidential and authenticated
- The user could log-out from the application
- **The user must authenticate to access the application**
  - The user will use a username and password to login
- **The user could see all the available players and interact with them**
  - The user will have a list of all the free users available
  - The user will select an adversary and send him a challenge
  - The user will see all the pending challenges
  - The user could withdraw a previous sended challenge
  - The user could accept or reject a challenge
- **The user could play a match with other players**
  - The user will have a dedicated window for play a match
  - A match is played by two users
  - A match is composed by rounds
  - In each round the control is assigned to the opposite player
  - In the first round the control is assigned to the player who has sent the challenge
  - In each round the user in charge selects an available column of the gameboard
  - Each round lasts a maximum of 15s

    - The first user who put four tokens in a row win
    - If all the gameboard is full without a winner the match ends with a tie
    - The user could logout from a match
    - The user who left a game automatically loses

- **During a match users could talk**
    - The user during a match became unavailable for challenges and reject automatically all the pending requests
    - Into the game window there will be a chat
    - The user during a match could always read messages from the chat
    - The user during a match could always write a message into the chat

- **The application has a rank table**
    - The user could see the ranks of all the users
    - A rank will be defined as $\langle TotalMatch, WonMatch, LostMatch, TieMatch\rangle$

1.2 System Requirements

- **The application is composed by a server and several clients which communicate remotely**
    - A client-server protocol is adopt for the communication between clients and server
    - A peer-to-peer protocol is adopt for the communication between clients
    - All messages must be confidential
    - All messages must be protected from replay
    - All messages must be authenticated
    - All messages must be sanified before being used by the application
    - There will be a symmetric session key for each sended message
    - Each user will have a personal RSA key
    - The private key of the user must be stored securely by the clients
    - The user RSA key will be generated by the client
    - The server will have a personal RSA key
    - The server will store all the PKE public keys of the users
    - RSA key will be used by users to cipher the peer-to-peer session keys and authenticate them
    - RSA key will be used by the server to cipher the client-server session keys and authenticate them

- **the GUI is composed by four windows**:
  - a Login/SignUp window
  - a Main window
  - a Game window
  - a Rank window
- **The first window showed is the *Login/SignUp* window**
  - The user could login with a username and a password
  - The user could register giving a username and a password
- **After a successfull login will be showed the *Main* window**
  - Into the main window there will be a list of the current player
  - Each player in the list shows its username and percentage of wins
  - The user can choose a user and send him a challenge
  - The user can make only one challenge a time
  - The user can withdraw the currently sended challenge
  - The user can see a list of all the pending received challenges
  - The user can reject a pending challenge
  - The user can accept a pending challenge
  - The user can reject directly all the pending challenges
  - The user can log-out from the application and return to the *Login/SignUp* window
  - The user can change the current window to the *Rank* window
- **The *Rank* window is accessible only from the *Main* window**
  - The user can see statistics of all the registered users
  - The statistics are defined as $\langle TotalMatch, WonMatch, LostMatch, TieMatch\rangle$all messages must be sanitized before being used by the application
  - The user could return to the *Main* window
- **If the user is active whenever a challenge is accepted the current window is changed to the *Game* window**
  - The *Game* window has a chat
    - The user during a match could always write into the chat
    - The chat is updated upon receipt of a message
  - The *Game* window has a matrix of 6x7 as *Gameboard*
  - The match is composed by rounds
  - During a round only one user can insert one token into the gameboard

  - The player who can insert the token is changed after each round
  - The first player who inserts four tokens in a row wins
  - If the matrix is full with no winner the match ends with a tie
  - Each round lasts at maximum 15 seconds
  - The user can log-out from a match and return to the main window
  - If a user log-out from a match he loses automatically

1.3 System Specification Document

- The application will be implemented in C++ with Secure Coding
- The application will use OpenSSL library for crypto algorithms
- The application will use .NET libraries to implement the GUI
- The server application will use a MySQL database to store information about registered accounts and stored public RSA keys
- The client and the server have a RSA key
- The RSA private key must be crypted using the user/server_administrator password
- The client must obtain the server RSA certificate from the server
- **The application will have a login window**
  - The login window will have a *Username* field
  - The login window will have a *Password* field
  - The login window will have a *SignUp* button
  - The login window will have a *Login* button
  - On click on the SignUp button the Username and Password field must be non empty
  - During login the client will send its username to the server
    - Message must be crypted with the client private RSA key
    - Message must prevent small message attack
    - Message must be secured against replay
    - Message must be protected against corruption
  - The client will receive after a login request a **LOGIN_SUCCESS**, **LOGIN_FAILURE** response
    - Message must be crypted with the client public RSA key
    - Message must be protected against replay
    - Message must prevent small message attack
    - Message must be protected against corruption

  - During a signup the user will send its username and its public key to the server
    - Message must be crypted with the server RSA public key
    - Message must prevent small message attack
    - Message must be secured against replay
    - The clients generate during each registration a new RSA certificate and save it
    - Message must be protected against corruption
  - When a server receives a login request it will control the authentication
  - After a successfull login server will generate an AES symmetric session key for the communications with the client
  - The client will receive after a SignUp request a **SIGN_SUCCESS** message including an AES symmetric session key or a **SIGN_FAILURE** response
    - Message must be crypted with the client public RSA key
    - Message must be protected against replay
    - Message must prevent small message attack
    - Message must be protected against corruption

- **After a successfull login the first page showed will be the Main Page**
  - The server will send a list of all the currently active users
  - Each user in the active users list is defined by its username and the percentage of the winned matches
  - The server periodically will send an *Update Message* to update the currently active users
  - An update message is a list of username with an ADD/REM status associated
  - Messages must be crypted with the AES symmetric session key
  - Messages must be protected against replay
  - Messages must be protected against corruption
  - There will be a list of all the active users
  - The user could click on a listed active user and send him a challenge by select him and click on the *Challenge* button
  - After the send of a challenge the *Withdraw Button* became available
  - After the send of a challenge the *Challenge Button* became unavailable
  - After the withdraw of a challenge the *Withdraw Button* became unavailable

- After the withdraw of a challenge the *Challenge Button* became available
- Clicking on the Unchallenge button will undo the challenge request
- In the main page there will be a list of all the pending challenge
- The challenge pending list will have an *Accept Button*
- The challenge pending list will have a *Reject Button*
- The challenge pending list will have a *Clean Button*
- If there isn't pending challenges the *Reject Button* is unavailable
- If there isn't pending challenges the *Clean Button* is unavailable
- If there isn't pending challenges the *Accept Button* is unavailable
- The user could select one user in the pending challenge list and accept his request by clicking on Accept button
- The user could select one user in the pending challenge list and reject his request by clicking on Reject button
- The user could delete all the challenge pending list by clicking on Clean button
- When a user Accept a challenge sends an ACCEPT message with the adversary username to the server and an AES session key
- When a user Accept a challenge the clients generate a new AES key to protect the peer-to-peer connection
- When a user sends a challenge sends a CHALLENGE message with the adversary username to the server
- When the server receives a CHALLENGE message control if it's a valid request
- When the server receives a valid CHALLENGE request it forward the message to the target user
- When the server receives an ACCEPT message controls if it's a valid request
- When the server receives a valid ACCEPT request it formward the message and the key to the target user

2 Application Mockups

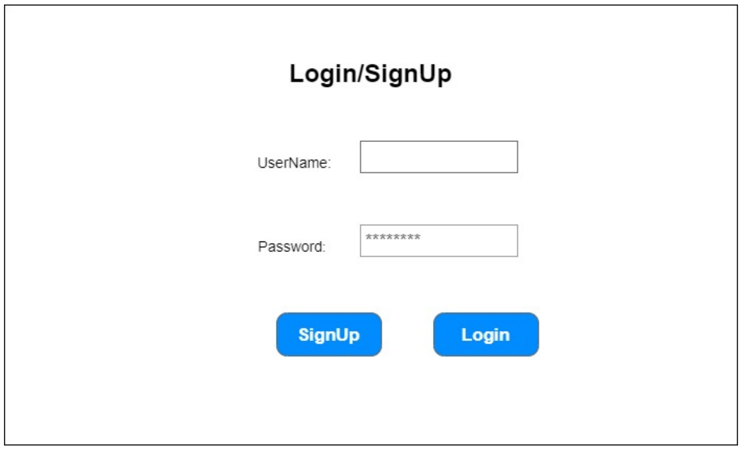
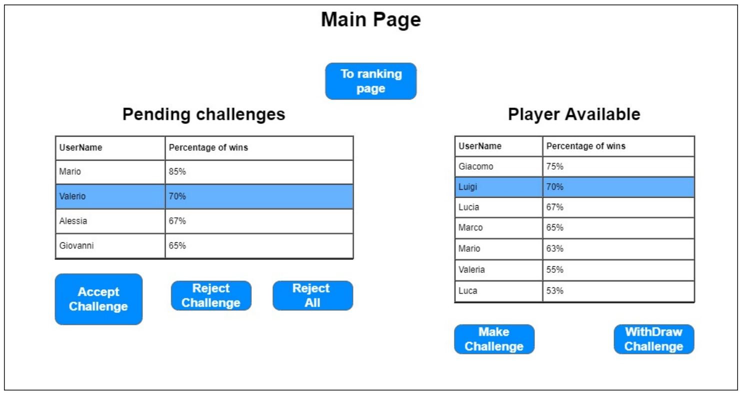


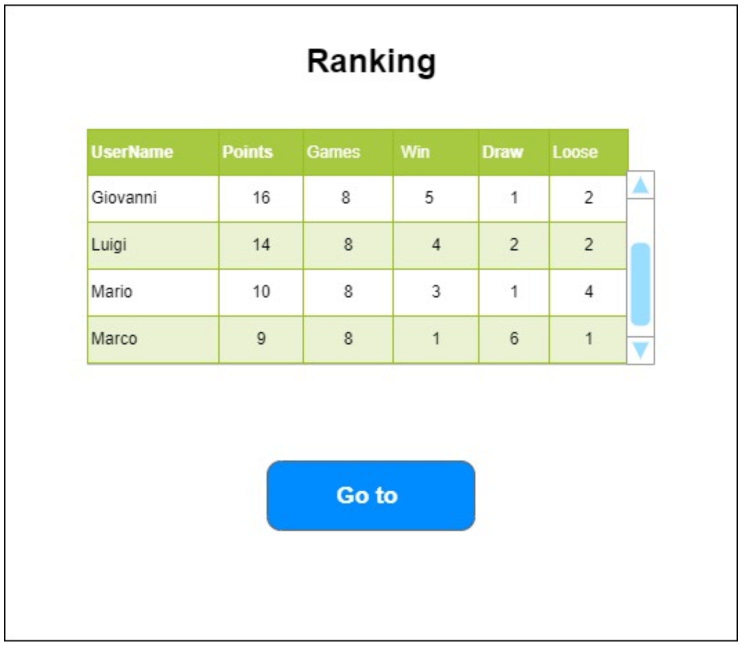
Figure 1: Login/SignUp page mockup



UserName	Percentage of wins
Mario	85%
Valerio	70%
Alessia	67%
Giovanni	65%

UserName	Percentage of wins
Giacomo	75%
Luigi	70%
Lucia	67%
Marco	65%
Mario	63%
Valeria	55%
Luca	53%

Figure 2: Application main page mockup



UserName	Points	Games	Win	Draw	Loose
Giovanni	16	8	5	1	2
Luigi	14	8	4	2	2
Mario	10	8	3	1	4
Marco	9	8	1	6	1

Figure 3: Rank page mockup

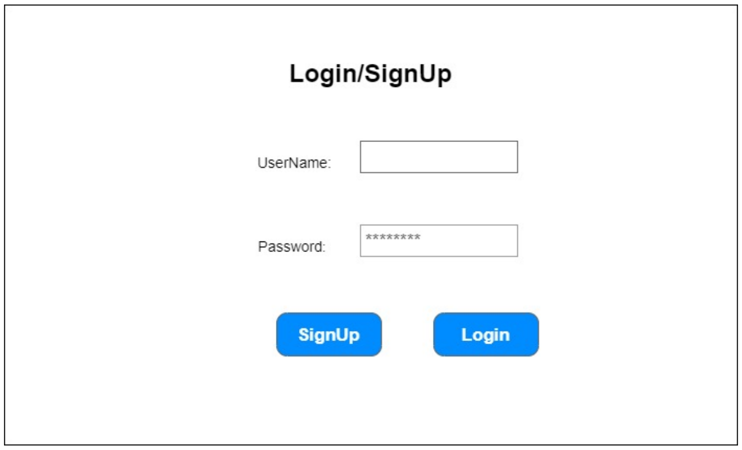


Figure 4: Game page mockup

3 Message Flow

4 UML Diagram