

Spectator Support Systems for Mahjong Novices by Displaying Candidate Tiles for Winning

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Research Outline

The screenshot displays a Mahjong game interface with the following details:

- Game State:** 東3局 0本場(リーチ0). 現在の盤面手数: 17. 牌山の残り枚数: 61.
- Players and Scores:**
 - 西 プレイヤー1: 36200点
 - 北 プレイヤー2: 32100点
 - 東 プレイヤー3: 21300点
 - 南 プレイヤー4: 18400点
- Hand Status:** ツモ (Moro) is indicated in the center.
- Analysis Table:** A table below the hands provides detailed analysis for each player's hand, including the number of required tiles (必要牌数), waiting tiles (待ち牌), and the lowest possible score (最低得点).

プレイヤー	必要牌数	待ち牌	最低得点
西	4	七、七、七、七	1000
北	3	六、六、六	2000
東	4	六、六、六、六	7700
南	3	南、南、南	5200

- Mahjong is a difficult game to watch for novices.
- One of the key reasons is the difficulty in understanding how close the players are to victory.
- We addressed this issue by proposing a spectator support system and confirmed its effectiveness through experiments.

Research Background

Shogi

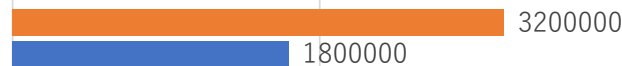
■ Spectator Population
■ Player Population



https://abema.tv/video/episode/268-13_s93_p79

Go

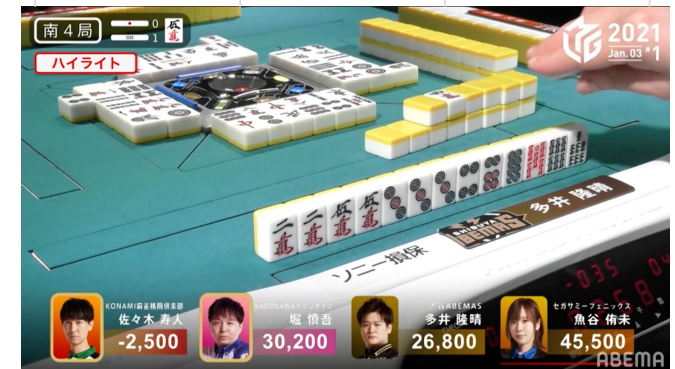
■ Spectator Population
■ Player Population



<https://www.youtube.com/watch?v=C6Hlylqmgts>

Mahjong

■ Spectator Population
■ Player Population



https://abema.tv/video/episode/444-12_s85_p39

Only for mahjong, the spectator population is less than the player population.

⇒ One possible reason is the lack of spectator support systems for mahjong.

Reference : <https://www.youtube.com/watch?v=fDglUu-a6ll>
<https://mj-news.net/news/20201118152452>

Research Background



https://abema.tv/video/episode/268-13_s93_p79



<https://www.youtube.com/watch?v=C6Hlylqmgts>



https://abema.tv/video/episode/444-12_s85_p39

- There are screen displays to assist spectators in shogi and go. These displays indicate which side the AI considers to be closer to victory and the best moves for each player, enabling spectators to engage in the viewing experience more effectively.
- However, Mahjong lacks such support. Therefore, we believe that providing appropriate spectator support for Mahjong could help solve this problem.

Approach to Problem Solving

Two factors that pose difficulties to watching mahjong and our suggestions

- The orientation of the tiles is inconsistent among players.
 - ⇒ Arranging the four players' hands in a single horizontal line on the screen.
- Difficulty in understanding the current situation of each player's hand
 - ⇒ Displaying the candidate tiles for winning



Standard mahjong interface

Proposed Interface

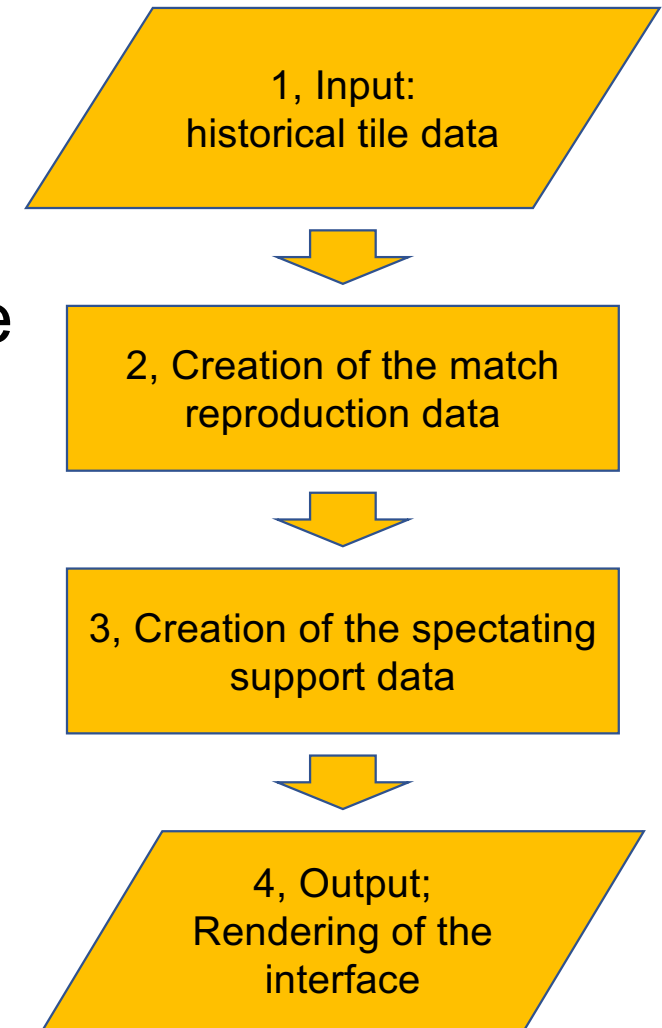
Horizontal alignment of all four players' boards

Display of candidate tiles for winning



Flowchart of the System

These features are implemented using the programming language Processing and consist of the following four processes.

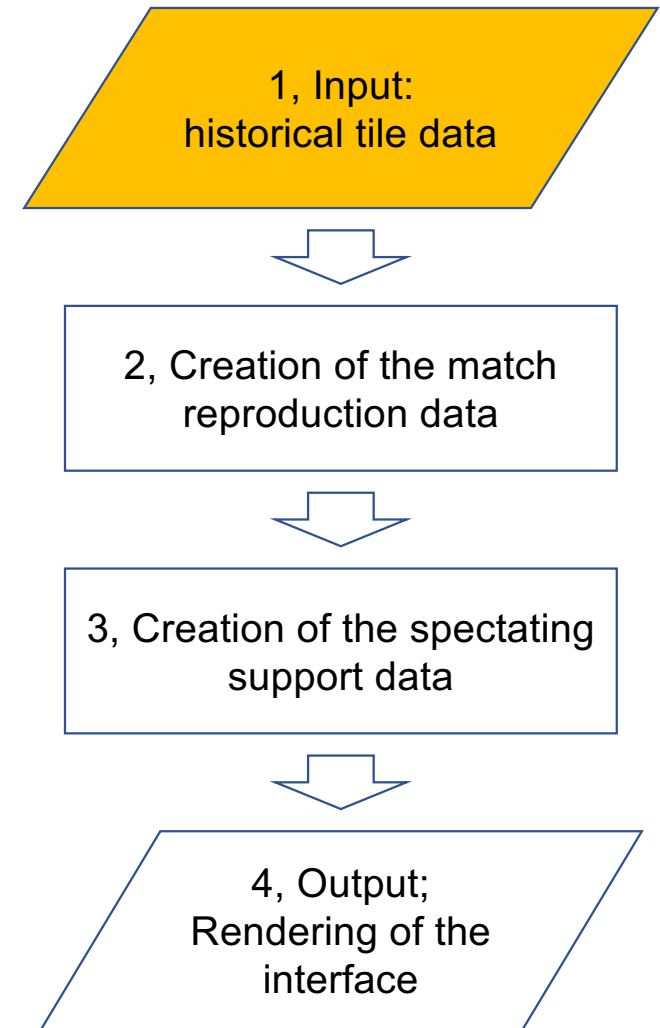


Input

- We use historical tile data published on the online mahjong site “Tenho”.
- This data includes basic information about the match, initial hands, and the actions taken by each player.

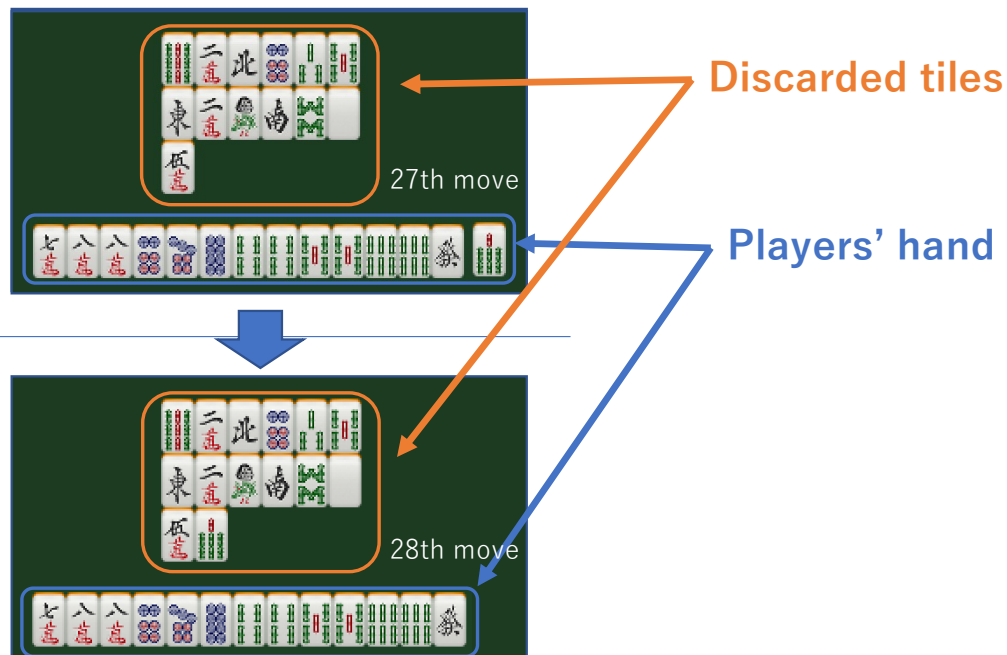
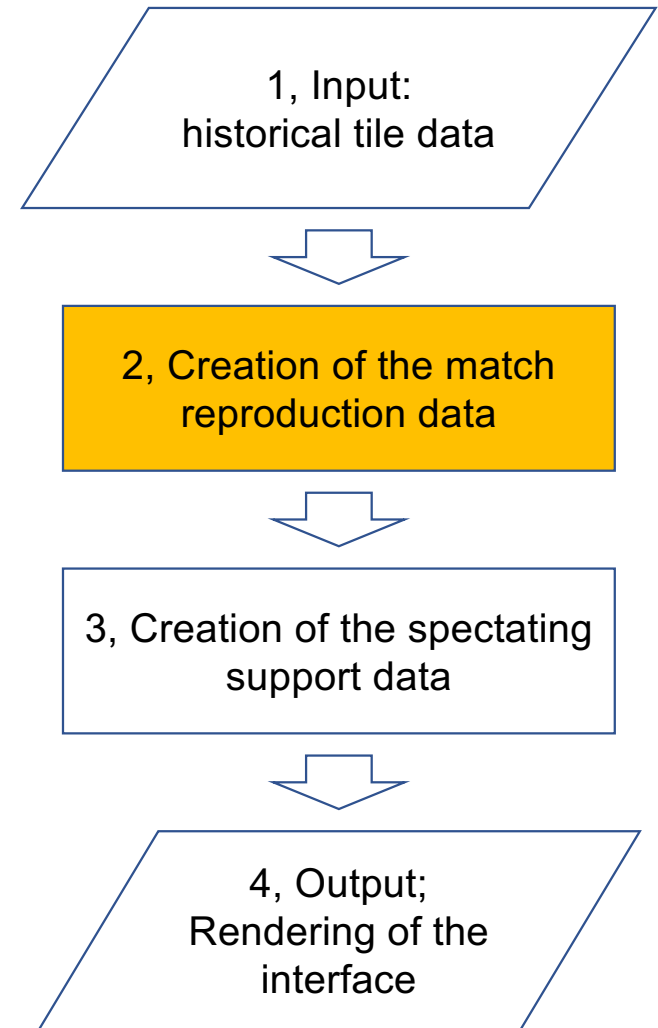
```
1  ===== 1t2t戦：仲間でワイワイ卓【麻雀7t心】 194卓 開始 2000/12/19 15:46 =====
2  持点27000 [1]泉れい R2062 [2]BIRD：静流 R2033 [3]1t風の狸 R2087 [4]詐欺師九十九 R2007
3  1t1局 0本場(リーチ0) BIRD：静流 2000 泉れい -1000 1t風の狸 -1000 詐欺師九十九 -1000
4  流局
5  [1南]1m6m9m9m2p6p6p8p3s6s6s8s2t
6  [2西]1m2m3m4m8m1p4p7p4s5s8s1t2t
7  [3北]4m6m7m4p5p7p2s5s5s7s1t6t7t
8  [4東]3m5m7m1p2p2p4p7p4s7s1t3t6t
9  [表ドラ]2s [裏ドラ]7m
10 * 4G8p 4D3t 1G2m 1D2p 2G5m 2D1p 3G5p 3D6t 4G7t 4D1p 1G5s 1D2t 2G8s 2D2t
```

Historical tile data



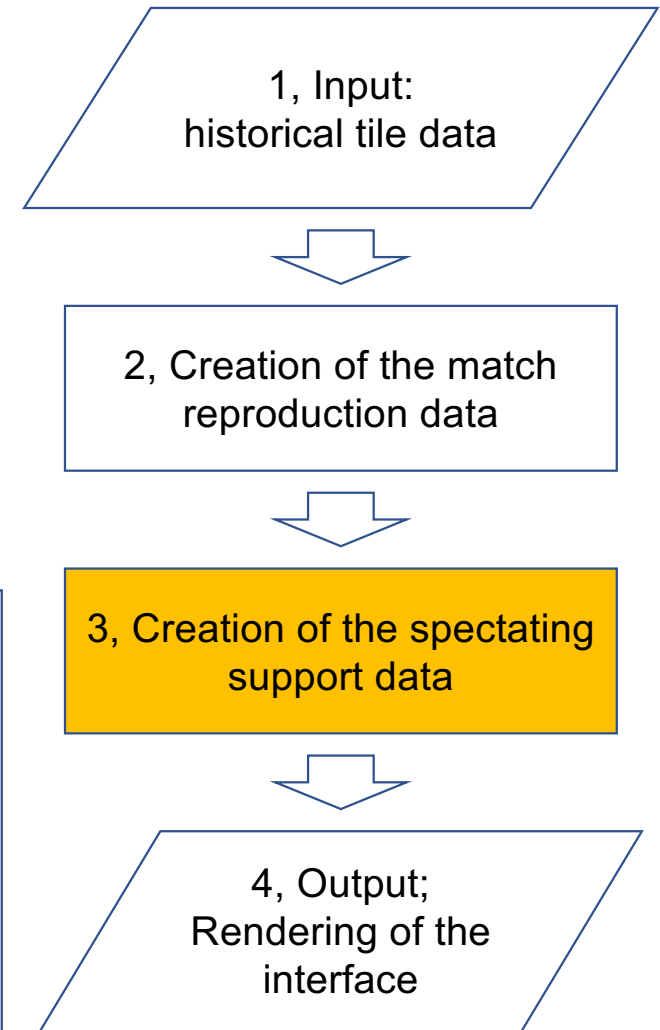
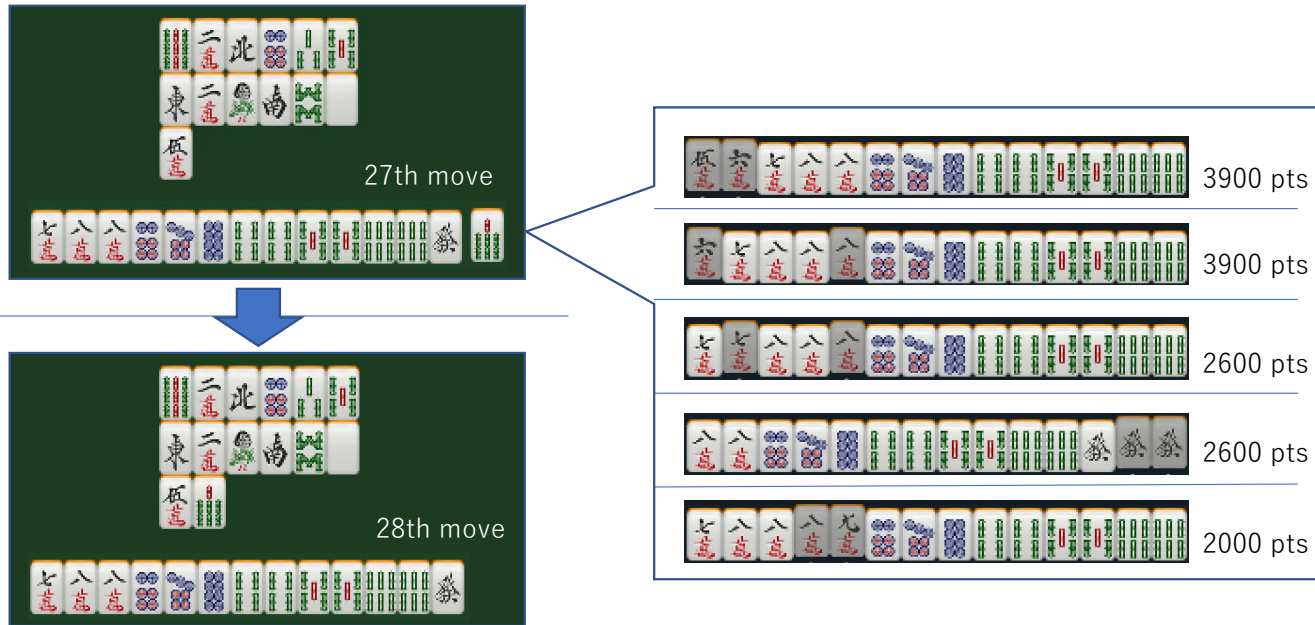
Creation of the Match Reproduction Data

Utilizing the input data to generate the players' hands and discarded tiles for each turn.



Creation of the Spectating Support Data

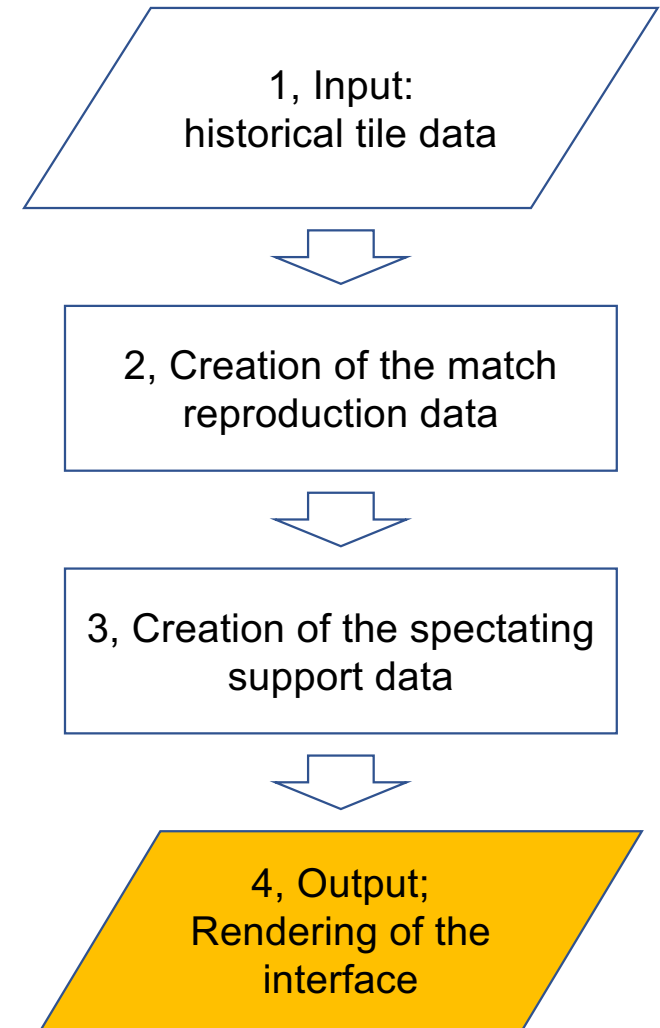
- Identifying the candidate tiles for winning that each player can form during each turn
- Retaining the top five candidate tiles with the highest expected points.



Output (1)

The actual game view based on the data created in Process 2

The display of the spectator support interface developed from the data from Process 3



Output (2)

The actual game view

The screenshot displays a Mahjong game in progress. At the top, the current hand count is 17 and the number of cards remaining in the wall is 61. The game is in the 3rd round (東3局) at the start of the match (0本場). The players are:

- 西 (West): プレイヤー1, 36200 points
- 北 (North): プレイヤー2, 32100 points
- 東 (East): プレイヤー3, 21300 points
- 南 (South): プレイヤー4, 18400 points

The center of the screen shows the 'ツモ' (Tsumo) phase. Below the main board is a spectator support interface. It features four columns, one for each player, showing various hand options. Each option includes a set of cards, the number of cards needed to complete the hand (必要牌数), and the minimum score (最低得点) for that hand. For example, the West player's options range from 1000 to 1000 points, while the East player's options range from 7700 to 2000 points.

The display of the spectator support interface

Evaluation Experiment

Objective

- To validate the effectiveness of the proposed interface.

Methods

- A comparative study employing the think-aloud protocol.
- The experimental group used the proposed interface, while the control group used a standard mahjong interface, both spectating the same match.
- Participants was instructed to verbalize everything they think during the spectating.
- The experiment included eight games, divided into two separate sessions.

Participants

- Participants consisted of five individuals in both the experimental group and the control group.
- They were assigned to each group to ensure an equal level of familiarity in spectating mahjong matches.

Evaluation Methods

- Using the utterance data obtained from the experiment.
- Comparison of observation time.
- Categorizing the types of utterances.
 - 1, Understanding e.g. "This player must want that tile,
 - 2, Questions e.g. "Why did they discard this tile?"
 - 3, Other e.g. "This game is interesting."

Results: Spectating Time

	1 st	2 nd	Increment
Experimental G.	28.1 (min)	19.1 (min)	-9.0 (min)
Control G.	22.3 (min)	22.9 (min)	+0.6 (min)

- In the experimental group, the spectating time in the second session was **9 minutes shorter** than in the first session.
- The experimental group had a shorter spectating time than the control group in the second session(=19.1 < 22.9).
 - ⇒ The interface improves spectating efficiency and becomes more intuitive with practice.

Results: Types of Utterances

Experimental G.	1 st	2 nd	Incr.
Understanding	64%	85%	+ 21%
Question	14%	8%	- 6%
Other	22%	7%	- 15%

Control G.	1 st	2 nd	Incr.
Understanding	68%	77%	+ 9%
Question	8%	10%	+ 2%
Other	24%	13%	- 11%

- The experimental group showed a significant increase in the proportion of “understanding” utterances(21%).
- By the second session, the experimental group surpassed the control group in understanding-related comments(85% > 77%).

⇒ The proposed interface supports better comprehension of the game over time.

Conclusion

- We proposed a spectator support interface for beginners watching Mahjong matches.
- By conducting a comparative experiment with a conventional interface, we demonstrated that the proposed interface improved both viewing time and the proportion of understanding-related comments.
- These findings confirm that the interface effectively supports Mahjong spectatorship.
- In the future, we plan to refine the interface further and expand its applicability to a broader audience.