iTTVis: Interactive Visualization of Table Tennis Data

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Table Tennis is Popular

- **300 million** active participants
- **552 million** television viewers
Traditional Analysis Methods VS Visualization

- Traditional analysis methods
  - Video analysis
  - Statistic charts
  - Mathematical models
Traditional Analysis Methods VS Visualization

- Visualization
  - Overview to detail
  - Pattern detection
  - Fast communication
Relevant Visualization Work

• Visualization for table tennis
Relevant Visualization Work

- Sports visualization

T. Polk et al., 2014

C. Perin et al., 2013

H. Pileggi et al., 2012

TenniVis

SoccerStories

SnapShot
Key Challenges (1/2)

- Difficult to understand and characterize the sophisticated domain problems of analyzing table tennis data

**terminology**

noun, plural ‘terminologies’
1. the system of terms belonging or peculiar to a science, art, or specialized subject: nomenclature.
2. the science of terms, as in particular sciences or arts.

Word Origin and History for ‘terminology’
1. from German Terminologie (1786), a hybrid coined by C.G. Schütz of Jena, from Medieval Latin terminologia, a speaking of limits.
Key Challenges (2/2)

- Difficult to provide a comprehensive and easy-to-understand visual representation of complex table tennis data

Time-varying

Location-based

Interrelated
Design Process
Characterizing domain problems
Designing an alpha prototype
Design Process

01/08/2016

12/12/2016

20/01/2017

Re-designing the beta system
Design Process

01/08/2016

12/12/2016

20/01/2017

15/02/2017

Enhancing the beta system
Our system contains the data of a **match**

Each match is played best 4 of 7 **games**

Each game can be divided in some **rallies**

Each rally is composed of several **strokes**
Data Structure

Rally
- Each rally contains a score

Stroke
- Each stroke contains three stroke attributes

Stroke technique
- Serve, Drop shot
- Block, Chop, Loop
- Parrel, Quick, Lob
- Smash, Cut, Flick

Stroke placement

Stroke position
Domain Requirements

Time-oriented analysis of an entire table tennis match

- *How do the scores evolve over time through a match?*
- *How can analysts navigate into key rallies on the match timeline and examine the details?*
Domain Requirements

Statistical analysis of three essential attributes

- How do stroke attributes **intra-relate** within a stroke?
- How do stroke attributes **inter-relate** between adjacent strokes?

![Stroke Sequence Diagram]
Pattern mining of tactics in table tennis matches

- *What are the frequent patterns of tactics?*
- *What are the scoring rates of tactics?*
Cross-analysis between the timeline and statistics

- How do the timeline and statistics relate to each other?

**key rallies**
System Overview

Match View
- Time-oriented analysis of a table tennis match

Stat View
- Statistical analysis of three essential attributes

Tactic View
- Pattern mining of tactics in a table tennis match

Cross-View interaction
- Cross-analysis between the timeline and statistics
System Overview

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- Time-oriented analysis of a table tennis match

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- Statistical analysis of three essential attributes

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Cross-View interaction
- Cross-analysis between the timeline and statistics
System Overview

- Time-oriented analysis of a table tennis match
- Statistical analysis of three essential attributes
- Pattern mining of tactics in a table tennis match

Match View

Stat View

Tactic View

Cross-analysis between the timeline and statistics

Interaction

Match View

Stat View

Tactic View

Cross-analysis between the timeline and statistics

Interaction
Load another match
System Overview

Match View
- Time-oriented analysis of a table tennis match

Stat View
- Statistical analysis of three essential attributes

Tactic View
- Pattern mining of tactics in a table tennis match

Cross-View interaction
- Cross-analysis between the timeline and statistics
System Overview

- Time-oriented analysis of a table tennis match

- Match View
- Statistical analysis of three essential attributes

- Stat View
- Pattern mining of tactics in a table tennis match

- Tactic View
- Cross-analysis between the timeline and statistics

- Cross-View

- Stat View

- Tactic View

- Stat View

- Cross-View
Design of Stat View

4 Placement

Position

Technique

5 Placement

Position

Technique
Design of Stat View

Diagram showing the process of design with stages labeled 4 and 5, and steps involving Placement, Position, and Technique.
Design of Stat View

Intra-stroke matrices

Long middle

Attr Value 1

Area

Luminance

Attr Value 2

Frequency

Position

Score rate
System Overview

Time-oriented analysis of a table tennis match

Match View
– Statistical analysis of three essential attributes

Stat View
– Pattern mining of tactics in a table tennis match

Tactic View
– Cross-analysis between the timeline and statistics

Cross-View
– interaction

Stat View

iTTVis - Interactive Table Tennis Visualization System

Match View

Stat View

Tactic View

Stroke View

History View

Stroke: technique, placement, position

Player1: 1, 3, 5
Player2: 2, 4
Case Study

Oh Sang-eun

Wang Hao
System Overview

Match View
- Time-oriented analysis of a table tennis match

Stat View
- Statistical analysis of three essential attributes

Tactic View
- Pattern mining of tactics in a table tennis match

Cross-View interaction
- Cross-analysis between the timeline and statistics
System Overview

- Time-oriented analysis of a table tennis match

Match View
- Statistical analysis of three essential attributes

Stat View
- Pattern mining of tactics in a table tennis match

Tactic View
- Cross-analysis between the timeline and statistics

Tactic View
- Interaction between tactics and players' positions

History View
Design of Tactic View
System Overview

- **Match View**: Time-oriented analysis of a table tennis match
- **Stat View**: Statistical analysis of three essential attributes
- **Tactic View**: Pattern mining of tactics in a table tennis match
- **Cross-View interaction**: Cross-analysis between the timeline and statistics
User Feedback

**Advantages**

- Employing matrices to represent the correlations
- Supporting flexible cross-view filtering and selections
- Designing icons and glyphs to enhance the intuitiveness

**Suggestions**

- Integrating prediction and supporting table tennis doubles
Conclusion

- Problem characterizing
- New insights
- A heuristic design
Future Work

- Support comparison of multiple matches
- Allow prediction of the winning rate
Q&A

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Follow along at
http://www.ycwu.org/projects/ittvis.html
Co-author
Data Structure

- Match
  - Each match is played best 4 of 7 games

- Game
  - Each game can be divided in some rallies

- Rally
  - Each rally is composed of several stokes

- Stroke
  - Each stroke is an elemental unit
Data Structure

Stroke

- Three stroke attributes

Serve, Drop shot
Block, Chop, Loop
Parrel, Quick, Lob
Smash, Cut, Flick

Stroke technique

Stroke placement

Stroke position
Design of Stat View

Intra-stroke matrices

Long middle

Inter-stroke matrix

5

Long middle

4

Position

Technique

Placement
Design of Tactic View

Placement

Position

Technique

Anti-sideways
Backhand
Forehand
Sideways

Scoring rate
Frequency
Tactic
Technique
Technique
Technique