CourtTime: Generating Actionable Insights into Tennis Matches Using Visual Analytics

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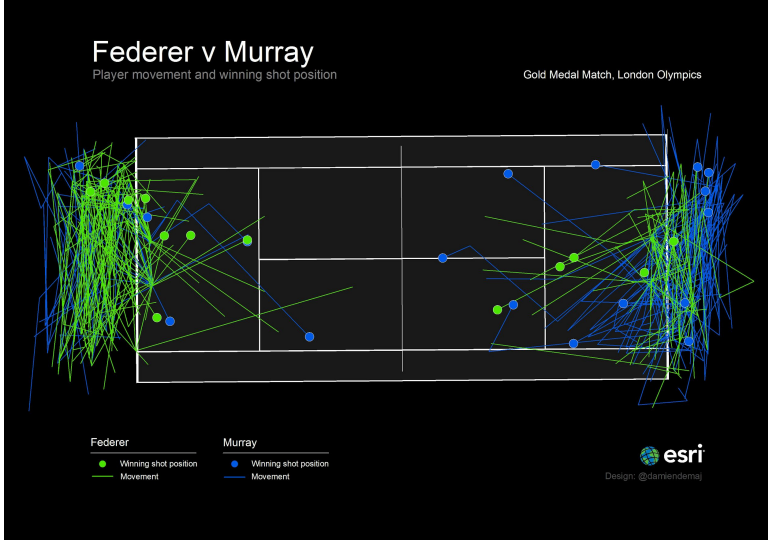
Background

- 3D ball and player tracking technology becoming commonplace
- Smart courts provide instant feedback
- Full advantage of these technologies is not taken
    - Improve specific shots
    - Help identify player's strengths and weaknesses
    - Helps identify successful strategies

Existing tools

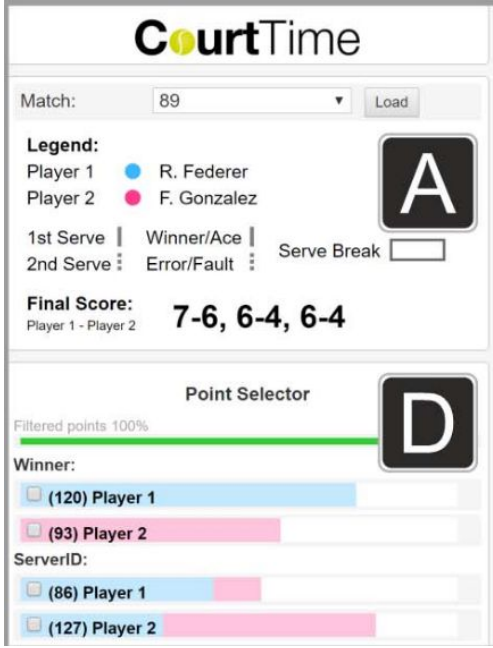
- Use summary statistics to describe a match
  - Points scored
  - Games won
  - Serve accuracy
- Use temporal and spatial information of a player
  - Player heatmaps
  - Ball landing plots



But these tools don't take into account the context of the game

CourtTime

- Use match metadata with spatial and temporal information
  - Game score
  - Who is serving
  - Serve side
  - Location of ball
  - Location of player ...



More information than summary statistics + spatial and temporal techniques

Overview of CourtTime

- Data extraction
  - Semi automated data collection
  - Annotated two matches: one professional and one amateur
- Visual analysis
  - Point selector
  - Point analyzer
  - Shot analyzer
- Video player: play points and videos of interest

Data (What)

- Two types of events (bounce events and hit events)
  - Location of ball
  - Location of player
  - Timestamp
  - Score
  - Serving player
  - Number of shots in point
  - Point outcome (winner, unforced error)

Deriving the Shot

- Aggregate bounce and hit events into a shot item
- (bounce-hit) or (hit-hit) -> shot
- Attributes
  - Sequence number
  - Reverse sequence number (number of shots until last shot)
  - Hitting player
  - Forehand or backhand
  - Location of ball and player for each event
- A collection of shots forms a point

Visualization

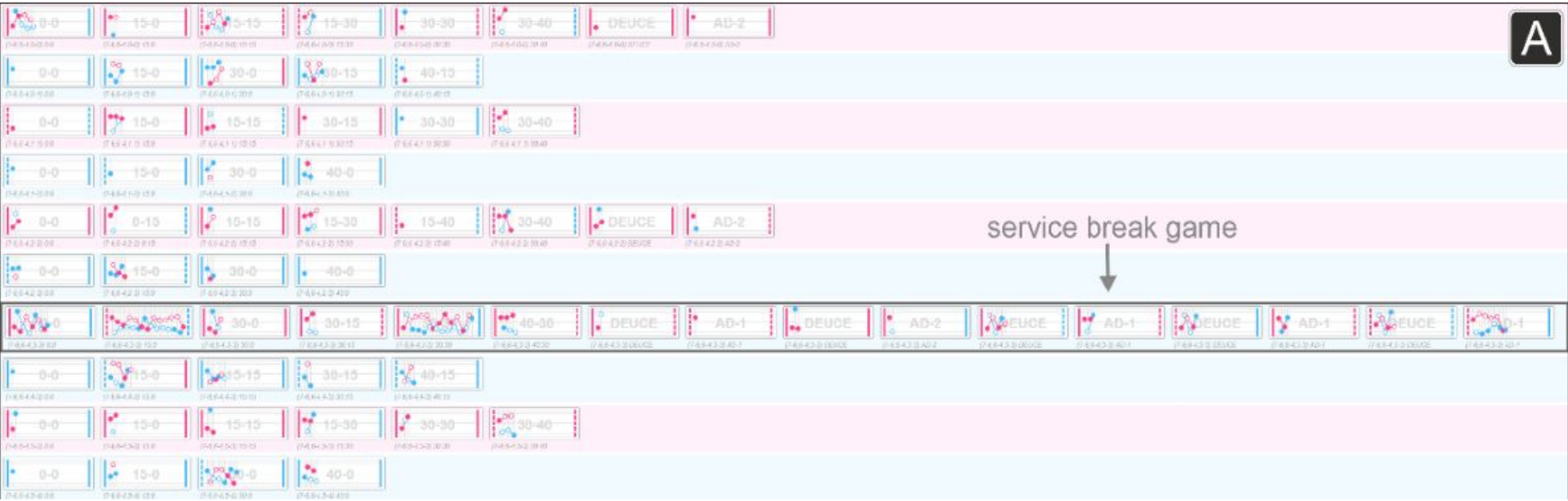
3 main components

- Point selector: Identify points to be analyzed
- Point analyzer: Used to further analyze selected points
- Shot analyzer: Used to further analyze a shot

Point selector

A search and overview task

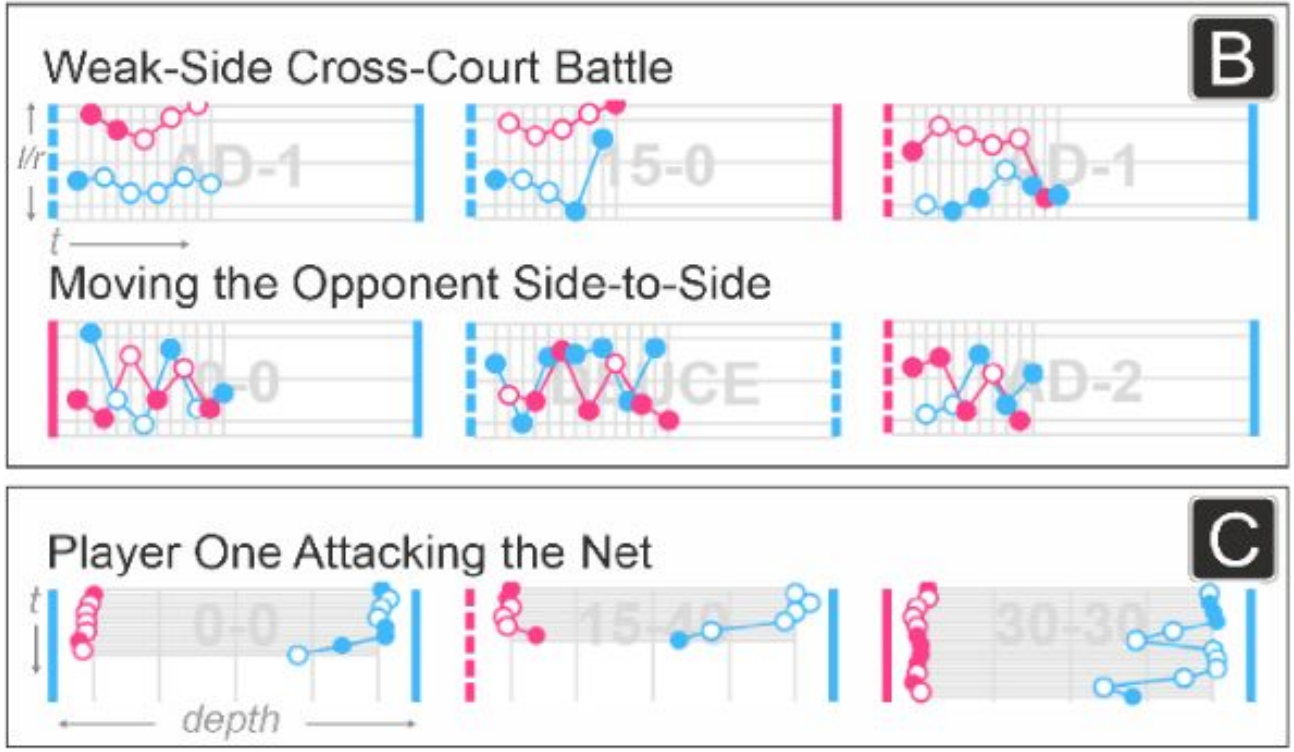
- Explore and locate points to be further analyzed
  - Search by who is serving
  - Search by points scored from a second serve
- Also gives summary level stats
  - Number of points lost with a specific stroke type
  - Number of second serves missed


A
service break game

Point analyzer

Allows users to look at one point with many different views

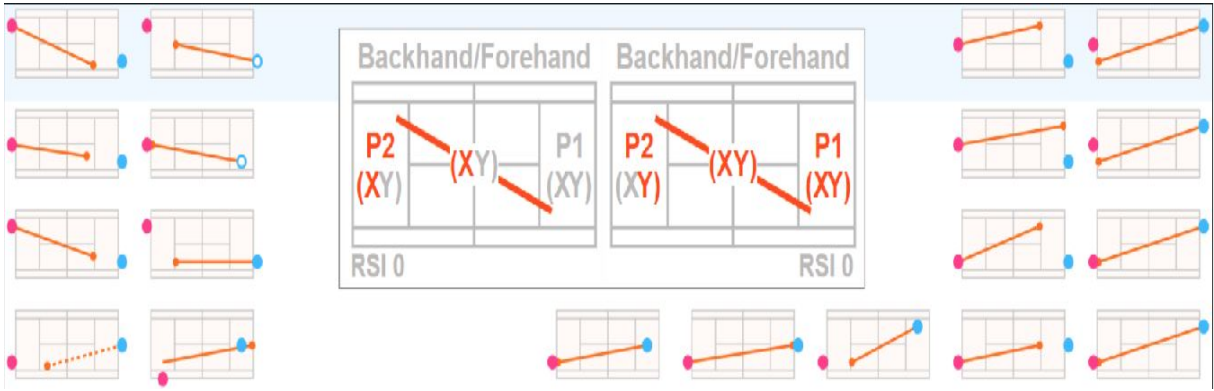
- 1-D line charts of player and ball locations for all shots in a point
- Left/right dimension or depth dimension
- Order points to help user find patterns
  - Order based on similarity of features
  - Users can select the features used in ordering
- Point analyzer + point selector help find what shots to analyze


B
Weak-Side Cross-Court Battle
l/r
t
AD-1
15-0
AD-1
Moving the Opponent Side-to-Side
0-0
DEUCE
AD-2
C
Player One Attacking the Net
t
0-0
15-40
30-30
depth

Shot analyzer

Allows users to make a more granular analysis

- Uses player location, ball location, and shot trajectory
- Also allows ordering of shots
  - Similarity metric used
  - User can select features
- Helps users see the why
  - Trends
  - Outliers
  - Correlations
  - etc...



Strengths

- Detailed information
- Reasonable tools to help users direct analysis
  - Game-> Point -> Shot
  - Ordering
- Good use of colour as identity channel
  - Easy way to distinguish between player 1 and player 2
- 1D encoding of depth and left/right reduces cognitive load

Weaknesses

- Too many channels used
  - Hard to remember everything
- Hard to gather data
  - 3 + hours per video
  - Manually annotated

Validation

- Observe target users using the tools
  - Did they understand the needs of users?
  - Did they show the right thing?
- Is their visual encoding/interaction idiom the right one?
  - Seems promising but..
  - No comparison to existing solutions
    - Is context data necessary?