

Orko: Facilitating Multimodal Interaction for Visual Exploration and Analysis of Networks

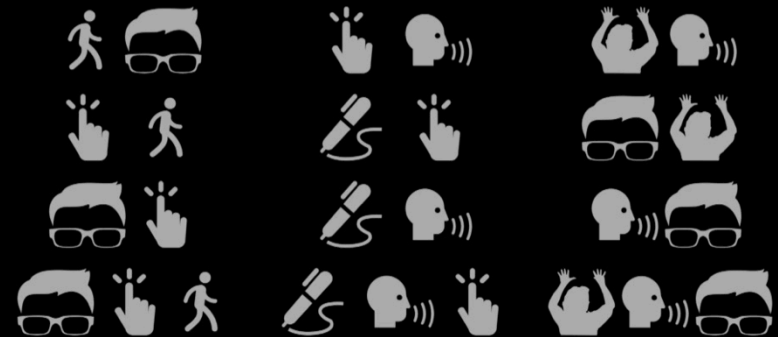
CPSC 547 – Networks Presentation
Peyvand Forouzandeh

What is Multimodal Interaction?

Using **two or more** modes of input/output

Different combinations:

- Touch and speech
- Movement and gaze
- Gestures and gaze
- Pen and touch
- ... or various combinations of these

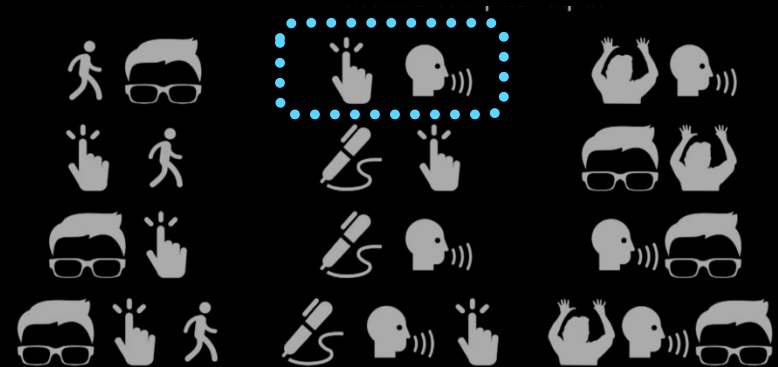


What is Multimodal Interaction?

Using **two or more** modes of input/output

Different combinations:

- Touch and speech
- Movement and gaze
- Gestures and gaze
- Pen and touch
- ... or various combinations of these



Data visualization user interfaces

- WIMP-based direct manipulation interfaces
- Post-WIMP systems
 1. Touch input
 2. Natural language interfaces (NLIs)

Data visualization user interfaces

- WIMP-based direct manipulation interfaces
- Post-WIMP systems

1. Touch input

2. Natural language interfaces (NLIs)



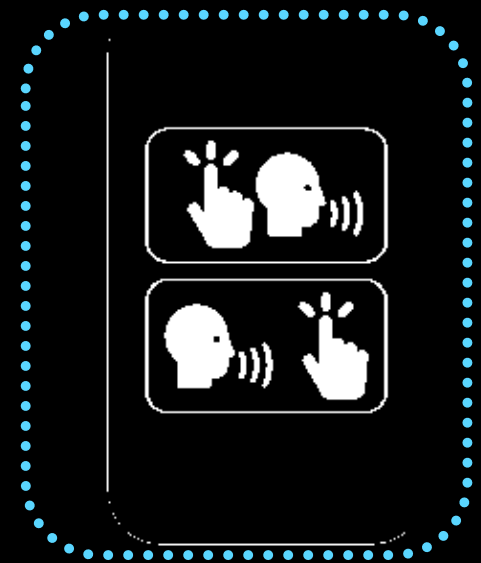
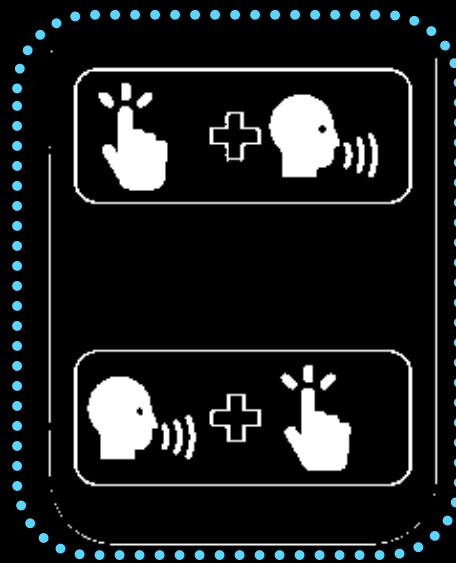
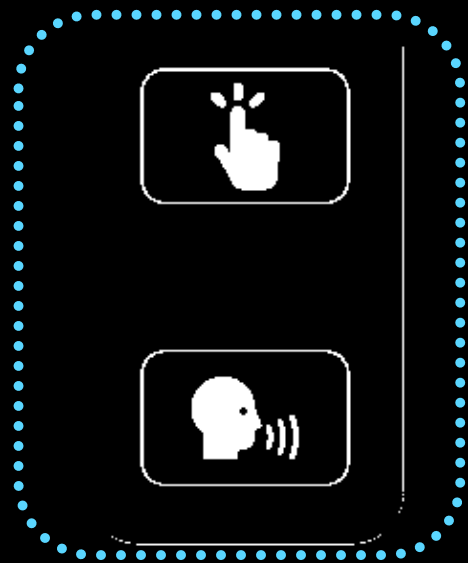
3. Multimodal interaction

Combinations of input modalities

Individual

Sequential

Simultaneous



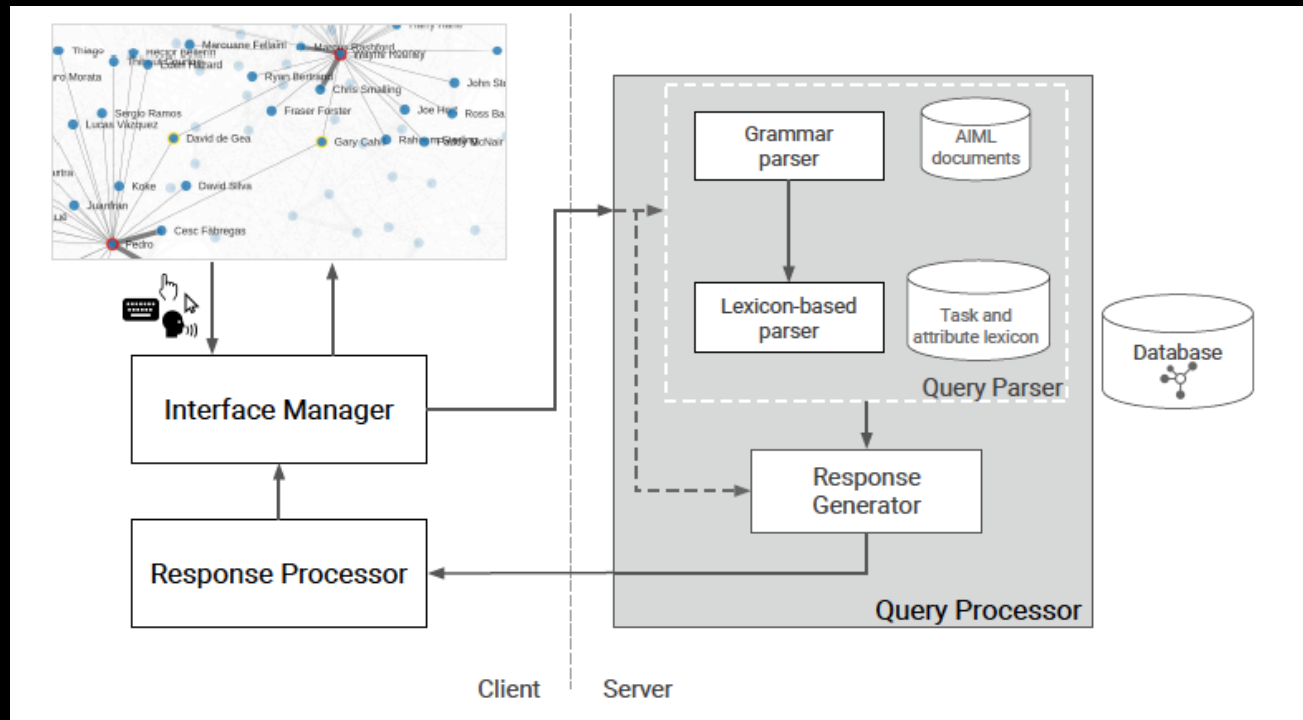
Challenges and complexities in interpreting NLI

- Multiple interpretation
- Different ways to ask the same query
- Ambiguity
 - Syntactic level
 - Semantic level

Possible query types

- **Explicit:** Operations and targets are specified (sufficient tasks and values information)
- **Follow-up and contextual:** Follow-up to the previous queries or actions (typically lack references to tasks or values associated with the task)
- **High-level:** open-ended questions; multiple operations combined together

System architecture

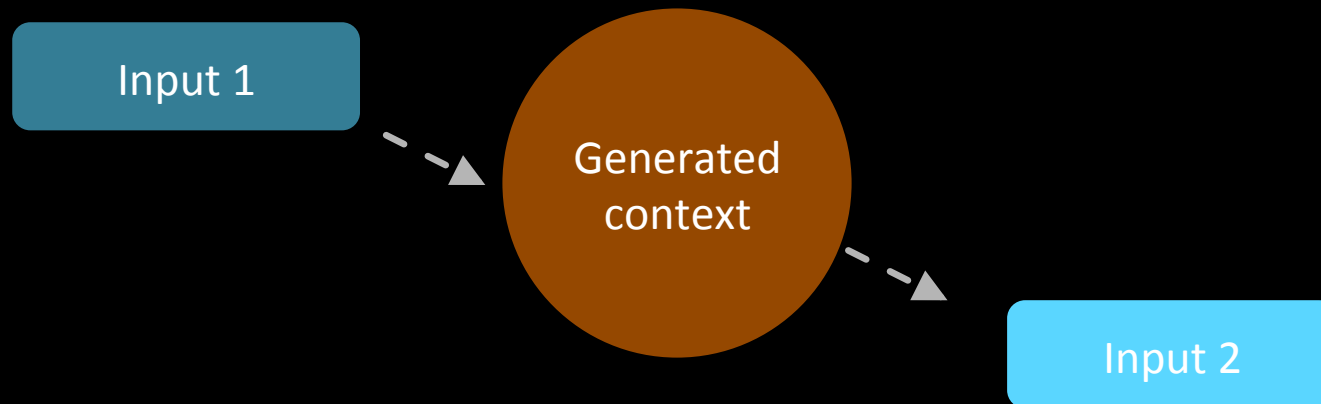


Two step approach parser:

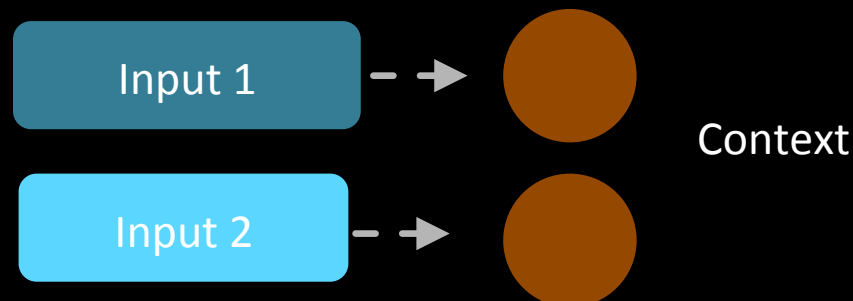
1. Grammar parser
2. Lexicon parser

Combinations of input modalities

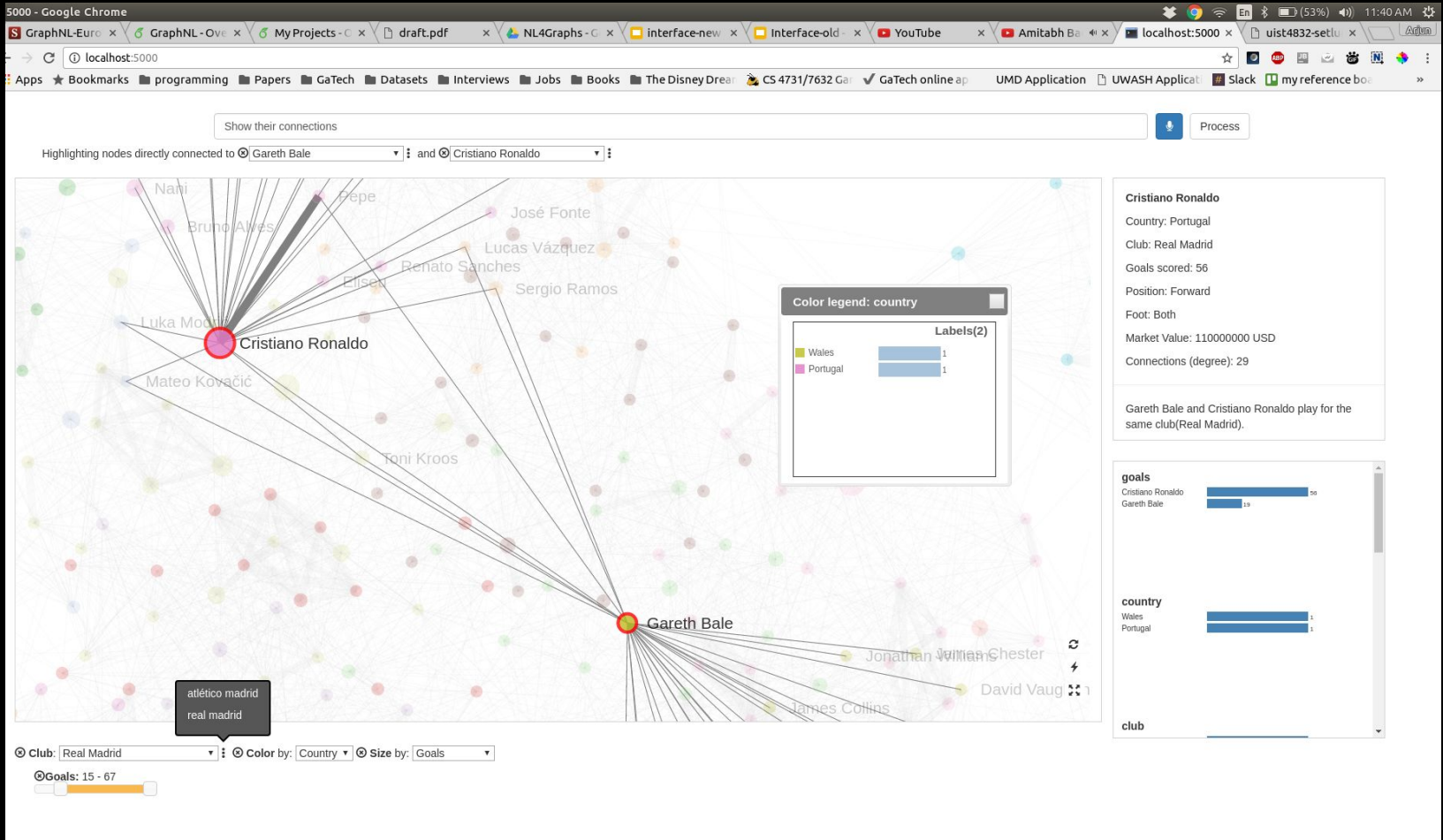
1. The context generated by one input is used to complement the second and highlight connections of the filtered nodes



2. The system processes the two inputs individually, preserving filters from the spoken query



Attributes and connections



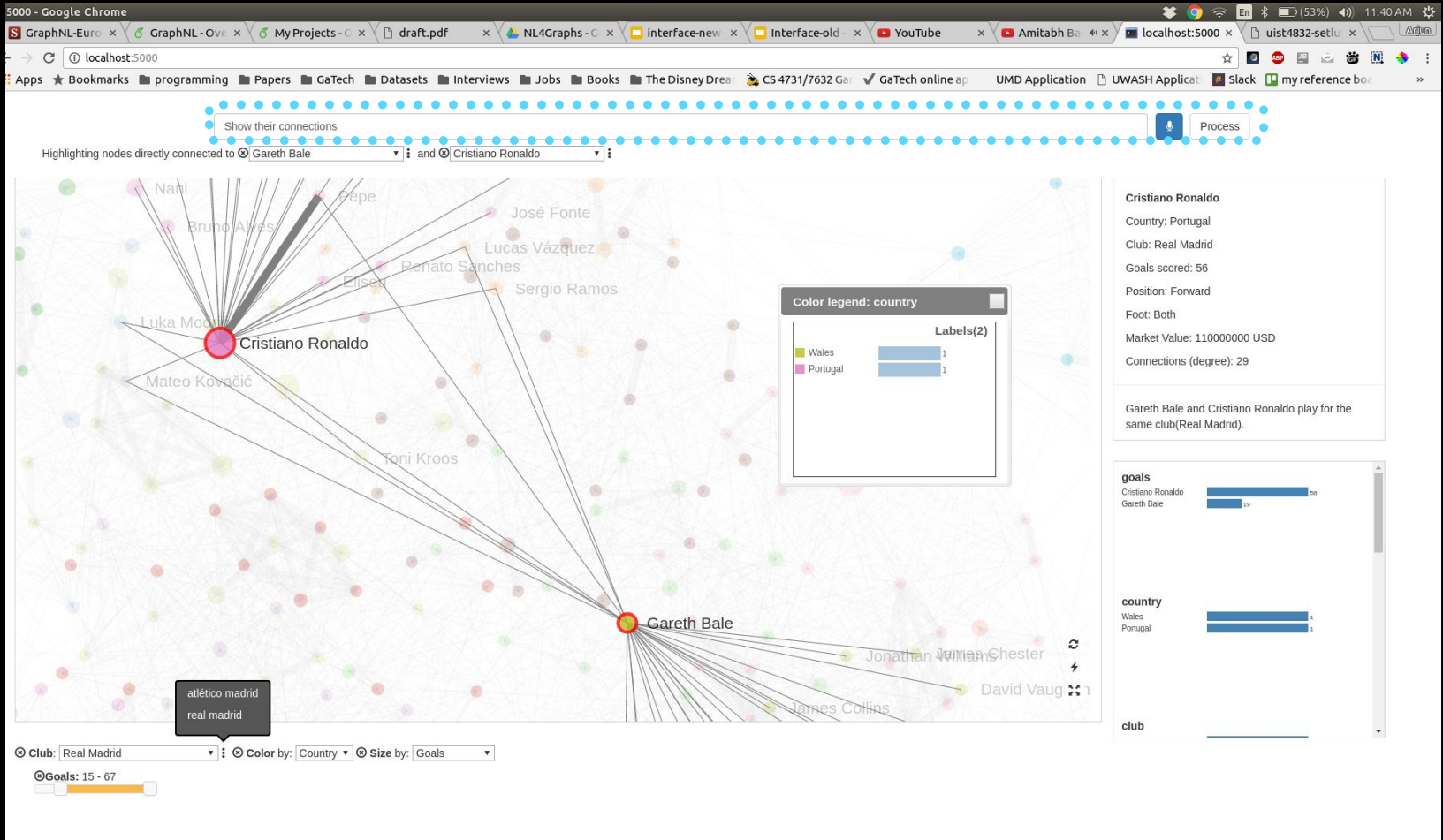
Orko



<https://vimeo.com/238502489>

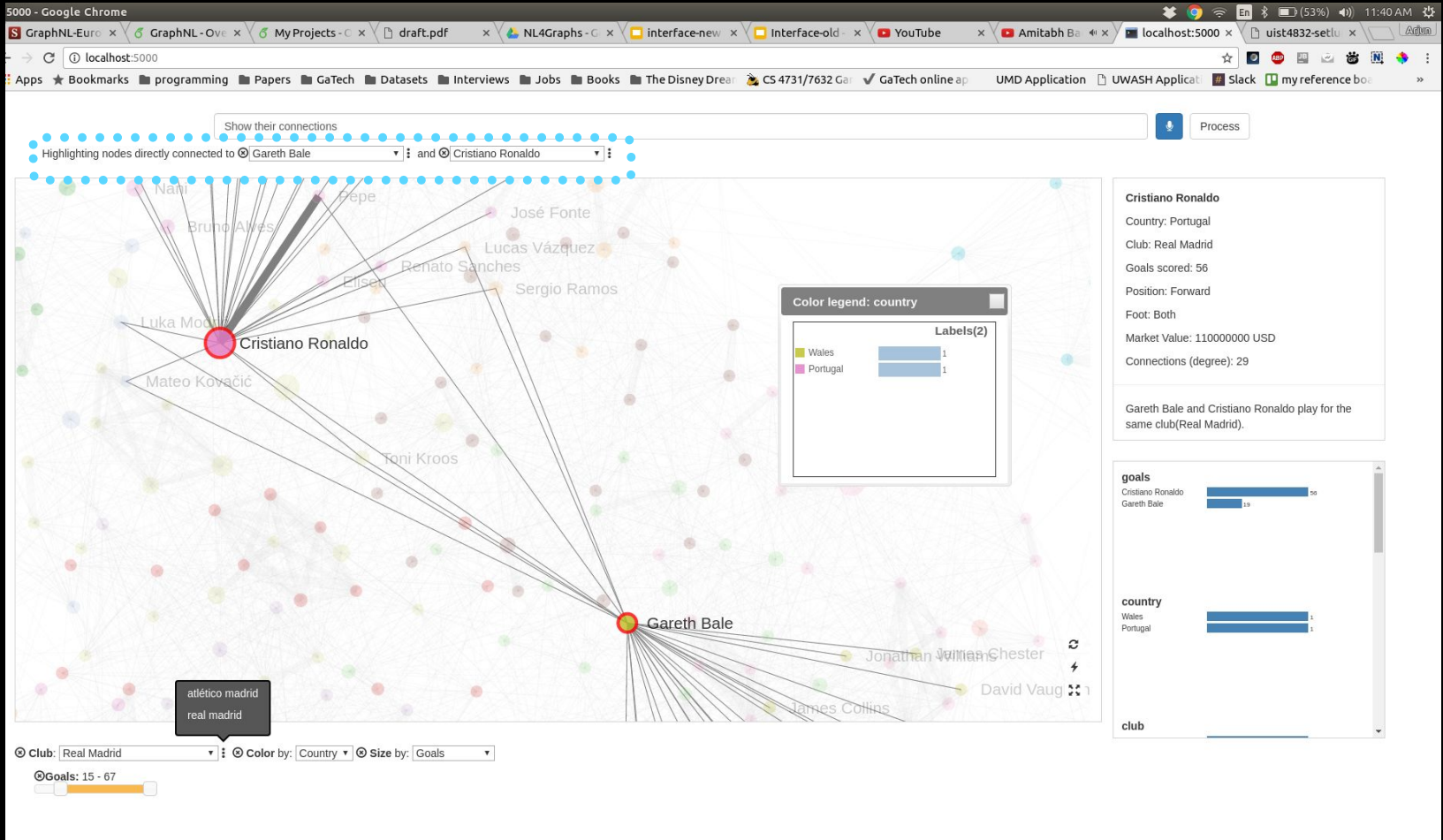
Orko's user interface

A: Natural language input and action feedback



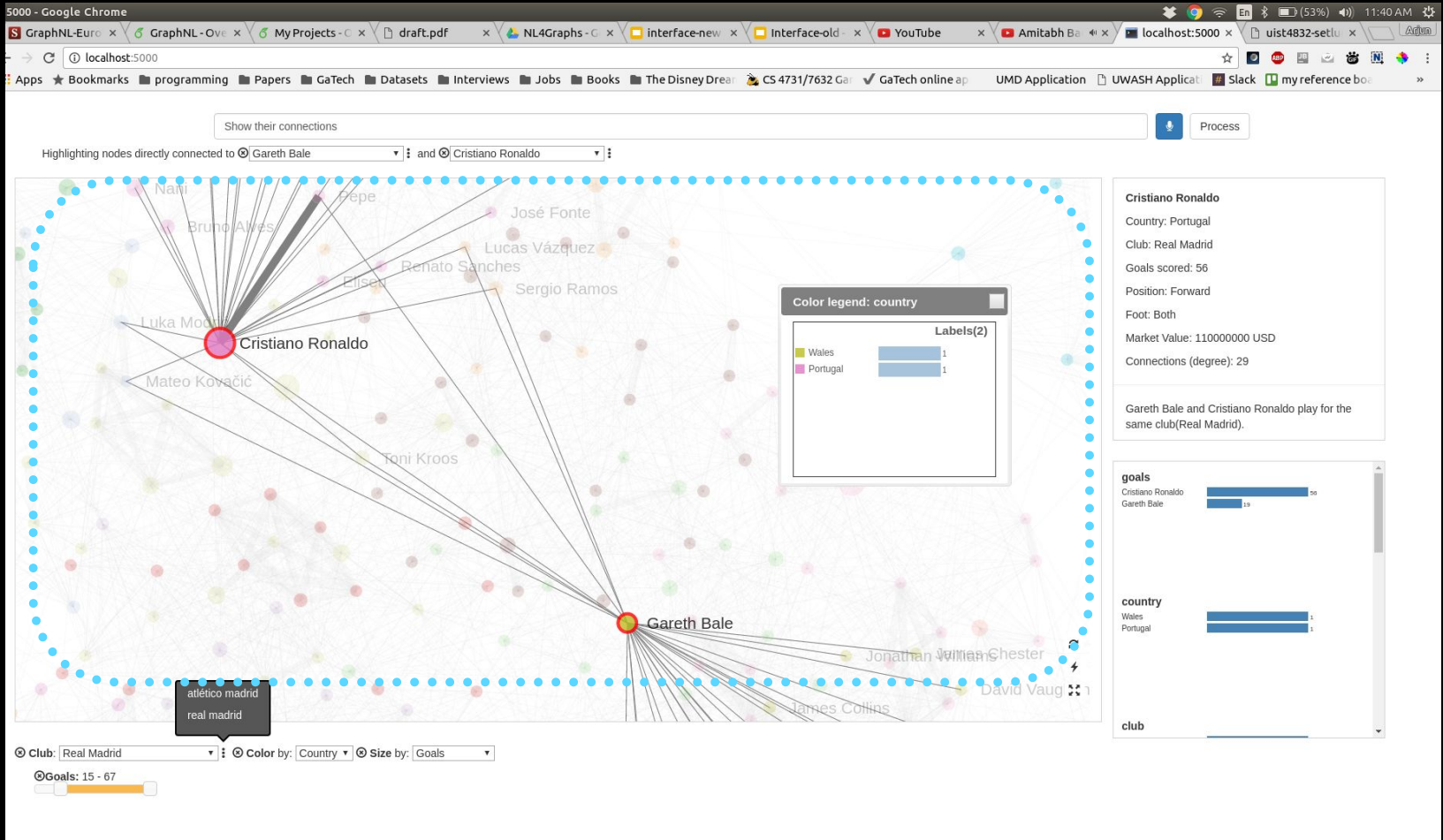
Orko's user interface

B: Action feedback



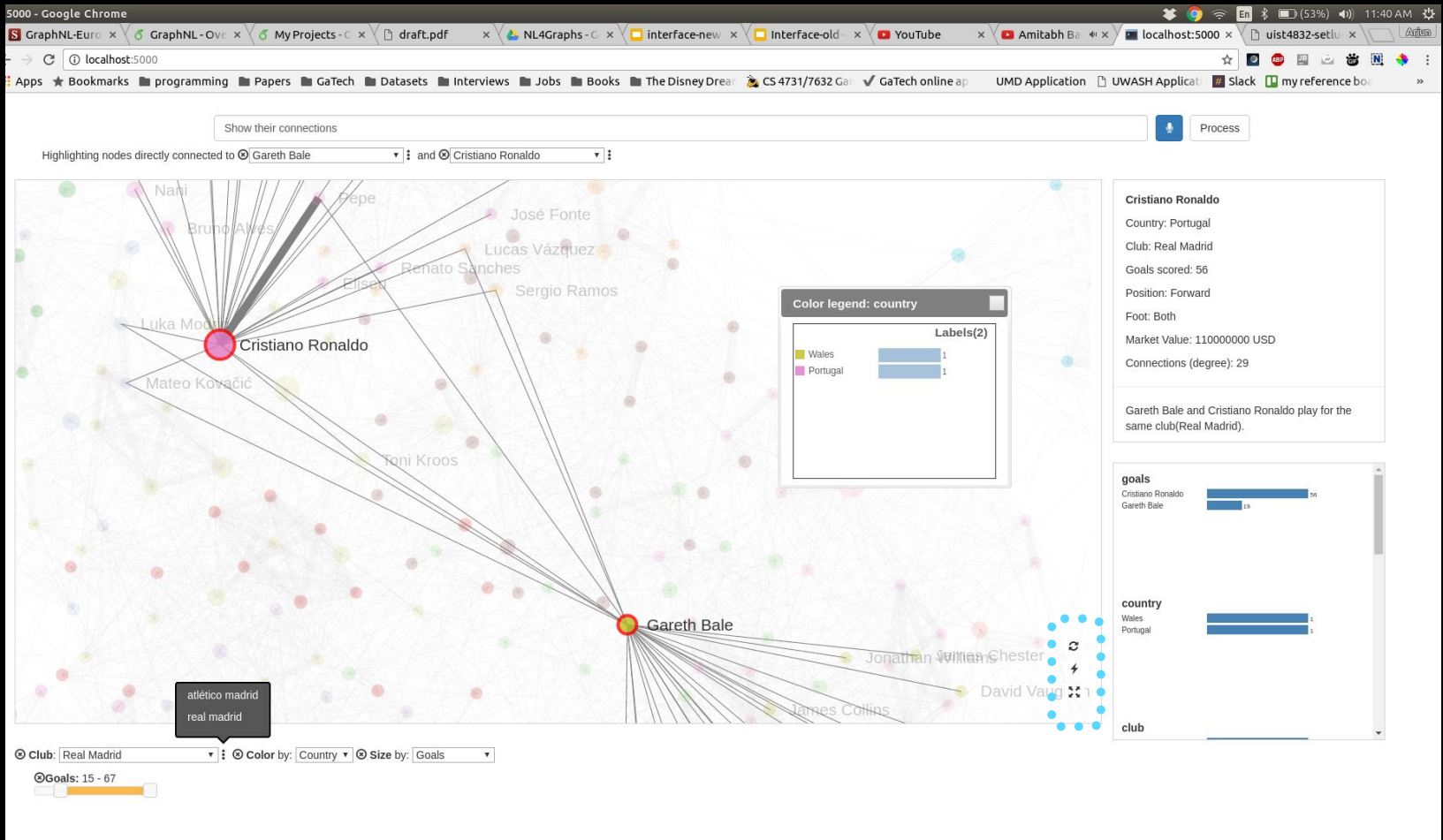
Orko's user interface

C: Network Canvas



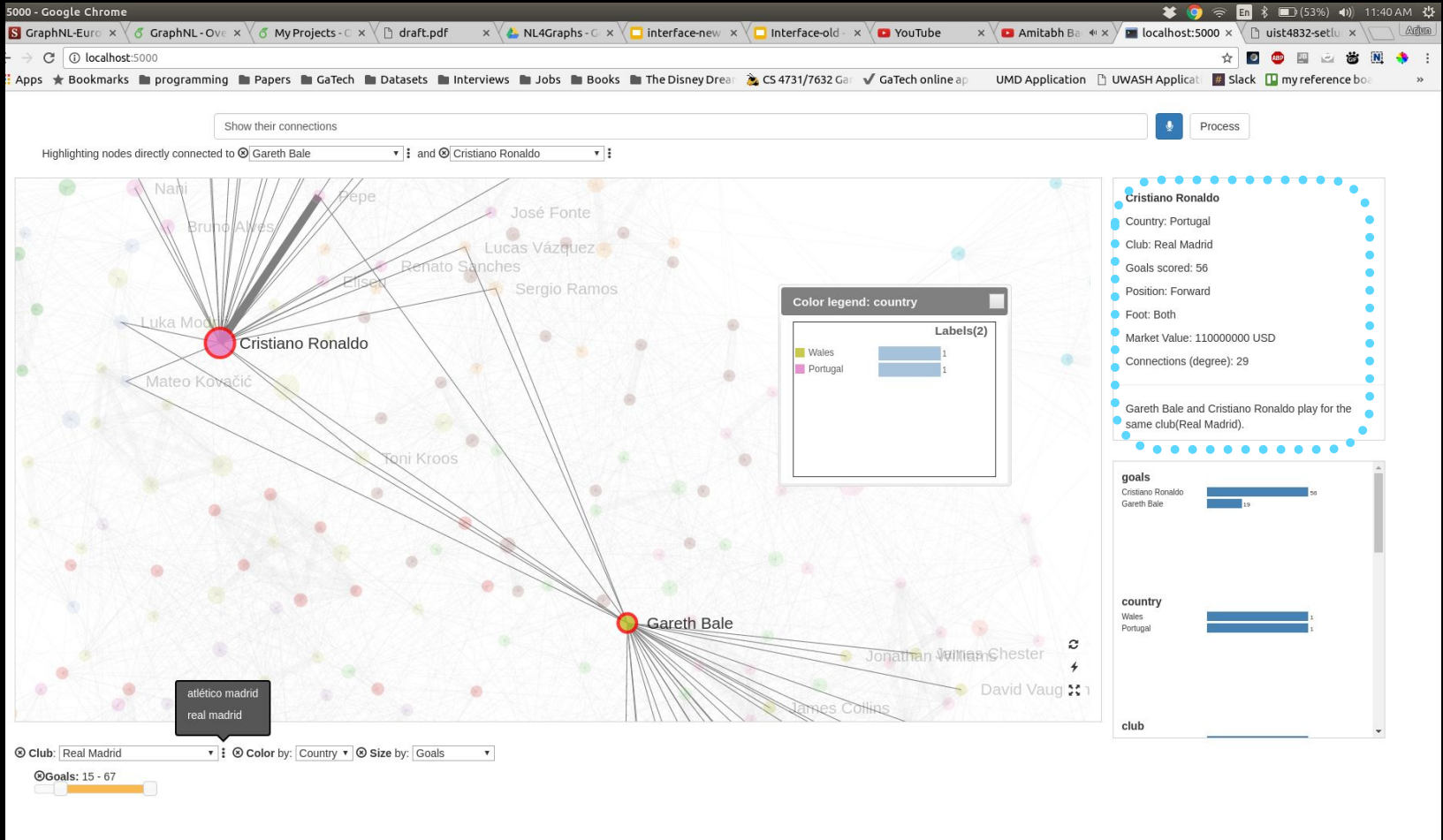
Orko's user interface

D: Quick access icons



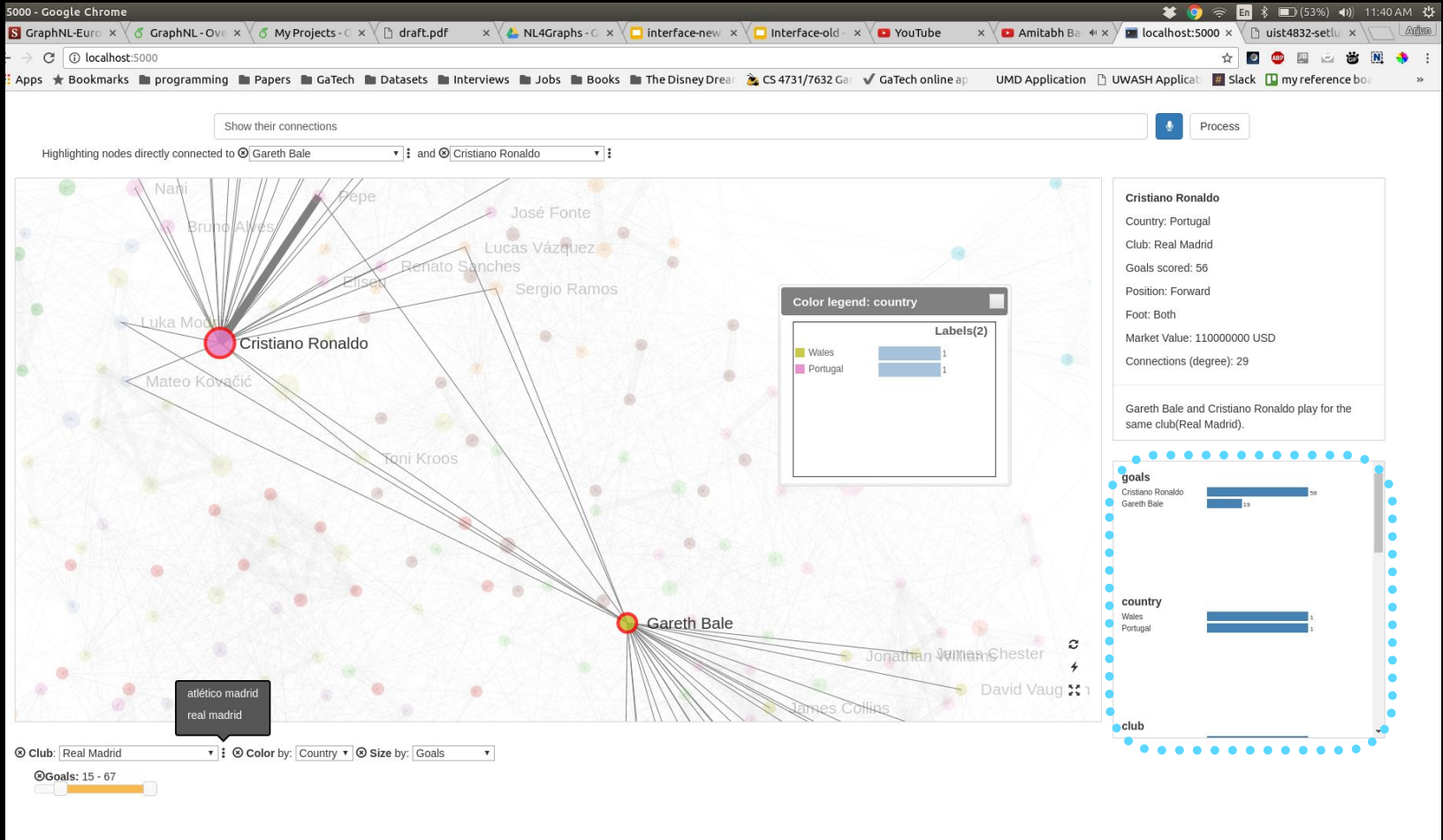
Orko's user interface

E: Details container



Orko's user interface

F: Summary container



Orko's user interface

G: Filtering widgets

The screenshot displays the Orko user interface in a Google Chrome browser window. The main area is a network graph of football players, with Cristiano Ronaldo and Gareth Bale highlighted in red. The interface includes several filtering and information widgets:

- Search and Filter:** A search bar at the top with the text "Show their connections" and a "Process" button. Below it, a filter bar reads "Highlighting nodes directly connected to Gareth Bale and Cristiano Ronaldo".
- Color Legend:** A legend titled "Color legend: country" showing "Wales" (yellow) and "Portugal" (pink).
- Player Information:** A panel on the right for Cristiano Ronaldo: Country: Portugal, Club: Real Madrid, Goals scored: 56, Position: Forward, Foot: Both, Market Value: 110000000 USD, Connections (degree): 29. Below this, it notes "Gareth Bale and Cristiano Ronaldo play for the same club(Real Madrid)".
- Goals Chart:** A horizontal bar chart titled "goals" comparing Cristiano Ronaldo (56) and Gareth Bale (55).
- Country Chart:** A horizontal bar chart titled "country" showing 1 for Wales and 1 for Portugal.
- Club Chart:** A horizontal bar chart titled "club" showing 1 for Real Madrid.
- Player Legend:** A legend at the bottom left for "atletico madrid" (blue) and "real madrid" (red).
- Global Filters:** A bar at the bottom with "Club: Real Madrid", "Color by: Country", "Size by: Goals", and "Goals: 15 - 67".

Orko's user interface

H: Visual encoding widgets

The screenshot displays the Orko user interface in a web browser. The main area is a network graph of football players, with nodes colored by country and sized by goals. Two nodes, Cristiano Ronaldo and Gareth Bale, are highlighted in red. A search bar at the top allows filtering by club and country. A 'Color legend: country' widget shows a legend for Wales (yellow) and Portugal (pink). A 'goals' widget shows a bar chart comparing Cristiano Ronaldo (29 goals) and Gareth Bale (15 goals). A 'country' widget shows a bar chart comparing Wales (1) and Portugal (1). A 'club' widget shows a bar chart for Real Madrid (1). A 'Show their connections' widget highlights nodes directly connected to Gareth Bale and Cristiano Ronaldo. A 'Process' button is visible in the top right. The browser's address bar shows localhost:5000. The browser's tabs include GraphNL-Euro, GraphNL-Over, MyProjects, draft.pdf, NL4Graphs, Interface-new, Interface-old, YouTube, Amitabh B, and localhost:5000. The browser's bookmarks include Apps, Bookmarks, programming, Papers, GaTech, Datasets, Interviews, Jobs, Books, The Disney Dream, CS 4731/7632 Ga, GaTech online ap, UMD Application, UWASH Applica, Slack, and my reference bo.

5000 - Google Chrome

GraphNL-Euro x GraphNL-Over x MyProjects - C x draft.pdf x NL4Graphs - C x Interface-new x Interface-old x YouTube x Amitabh B x localhost:5000 x uist4832-set(u x

localhost:5000

Apps Bookmarks programming Papers GaTech Datasets Interviews Jobs Books The Disney Dream CS 4731/7632 Ga GaTech online ap UMD Application UWASH Applica Slack my reference bo

Show their connections

Highlighting nodes directly connected to Gareth Bale and Cristiano Ronaldo

Cristiano Ronaldo

Country: Portugal
Club: Real Madrid
Goals scored: 56
Position: Forward
Foot: Both
Market Value: 110000000 USD
Connections (degree): 29

Gareth Bale and Cristiano Ronaldo play for the same club(Real Madrid).

goals

Cristiano Ronaldo 29
Gareth Bale 15

country

Wales 1
Portugal 1

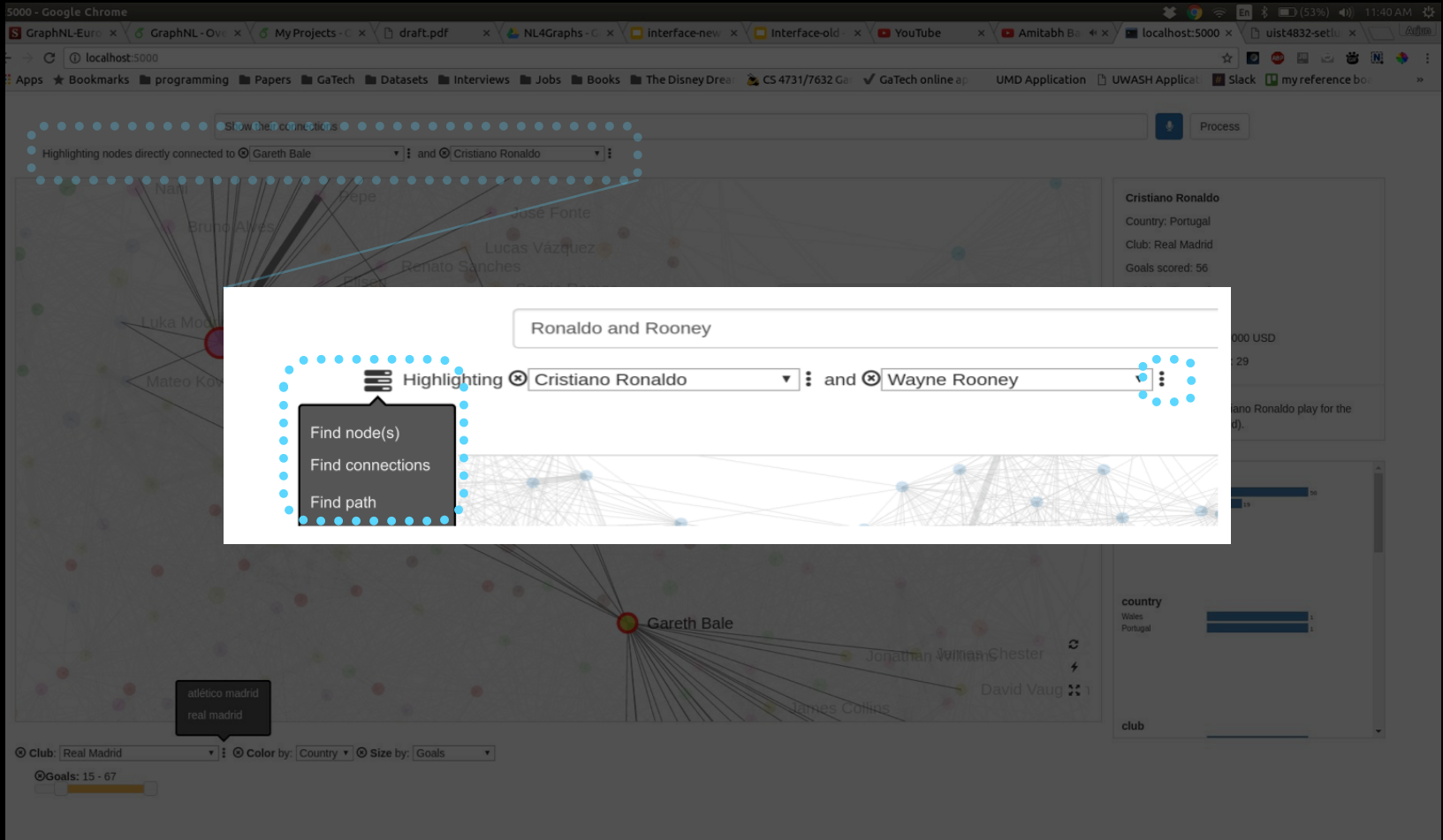
club

atletico madrid
real madrid

Club: Real Madrid
Color by: Country
Size by: Goals
Goals: 15 - 67

Orko's user interface

B: Action feedback – Ambiguity widget



Evaluation – user study

- Jeopardy-style evaluation approach
 - Facts: to modify the visualization and show each fact
 - Tasks: 10 tasks to explore the network and identify specific entities
 - Questions: to measure satisfaction and usability
 - Informal interview

Evaluation – user study

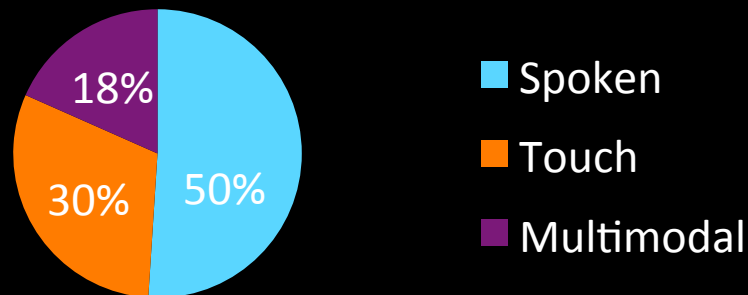
	P1			P2			P3			P4			P5			P6				
	S	T	ST	S	T	TS	S	T	ST	S	T	ST	S	T	ST	S	T	ST	TS	
T1			1	2					1			1			1	1				
T2	2			1			1					1			1	1				
T3	2	2	1	3	1		1		1	3	1		3	1		2				
T4	2		1	3			4					3		6		3				
T5	2			2				1	1			1	2	4		4	1	1		
T6	1		1	1				2	1	1			1	3		4				
T7	1	1		2	3		1	1	1		1	1	3	1		2	2			
T8	1		1	1			1	1	1			1	2	1		1				
T9	2			2					2	2			2	1		1		2		
T10	2	2	2	8	1	2		6	2	2	5		2	5		2	3			1

Summary of interactions per task for 6 participants

Results and observations

- Preferences of modalities:
 - **Speech**: typically for search, filtering, and topology-based tasks involving multiple nodes
 - **Touch**: typically for tasks like highlighting connections of individual nodes and changing values of existing graphical encodings

Modalities preferred



Results and observations

- NLI and interpretation
 - Query interpretation: Issues with queries with multiple values and not separated by conjunctions
- Contextual and follow-up queries
 - Multitouch gestures: requested
 - Repeat preference: instead of follow-up utterances
- Proactive behavior

Critique

- Natural and fluid way to explore networks
- Features well integrated
- Clear breakdown and UI
- Immediate visual feedback and proactive behavior (help user think about other questions)
- Flexibility of choices between audio and textual feedback
- Successful in explicit queries and most follow-up and contextual

- Evaluation – experienced participants and specific example (Football)
- Only force-directed layout (Region-based identifications not useful – Scalability issues)
- Limited touch gestures
- Some features not used (ambiguity widget, follow-up gestures, task suggestions)
- Simultaneous interaction was not examined
- Ignored high-level questions
- Auto-complete function