

Supporting Graph Exploration Tasks on Display Walls Using Spatially-Aware Mobile Devices

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Introduction

In the rapid advancement towards an information era the importance of comprehensive data sets and its accessibility increases enormously - large information visualizations and suitable interaction techniques become a key element for productive work. Many data sets can be represented in a graph structure where pairs of objects are connected by links. The node-link representation of a graph is easy to grasp and human readable, but loses its clarity with an increasing amount of complexity because the visualization gets cluttered. One possible solution to address this problem is the use of larger screens, which provide enough physical space to display large graph sets. We present novel approaches, which provide a focused, personal view onto the wall-sized graph data representation by using personal mobile devices to support selection, show details, filter tasks as well as consider the spatial position of the user.

Design Principles

The foundation of our concepts lie in taking advantage of the space on and in front of wall-sized displays to support large data exploration. For our concepts, we assume

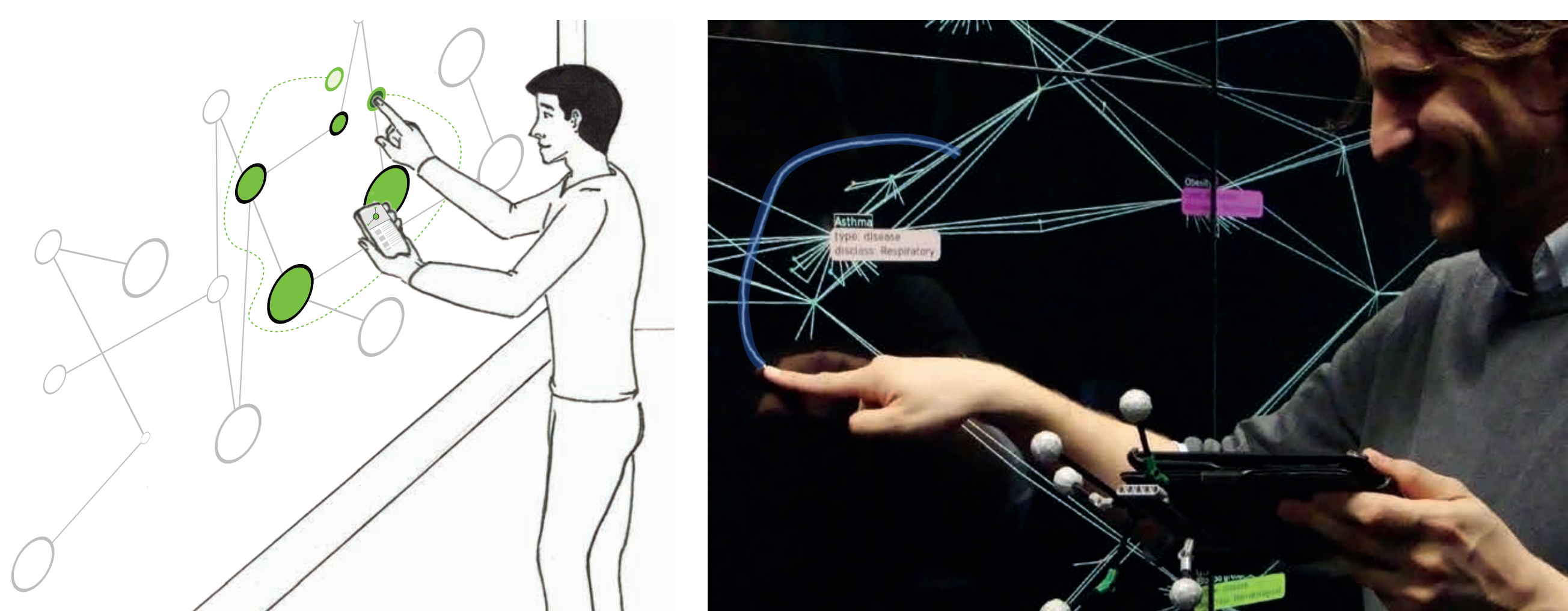
- display wall ▶ main visualization and overview of the information space.
- mobile display ▶ individual, personal views, focus and additional information.

The mobile device's position and movement (and as a result an estimate of the user's position) is tracked in the space in front of the wall-sized display, so that individual interactions with the mobile device can be linked and related to specific objects on the display wall.

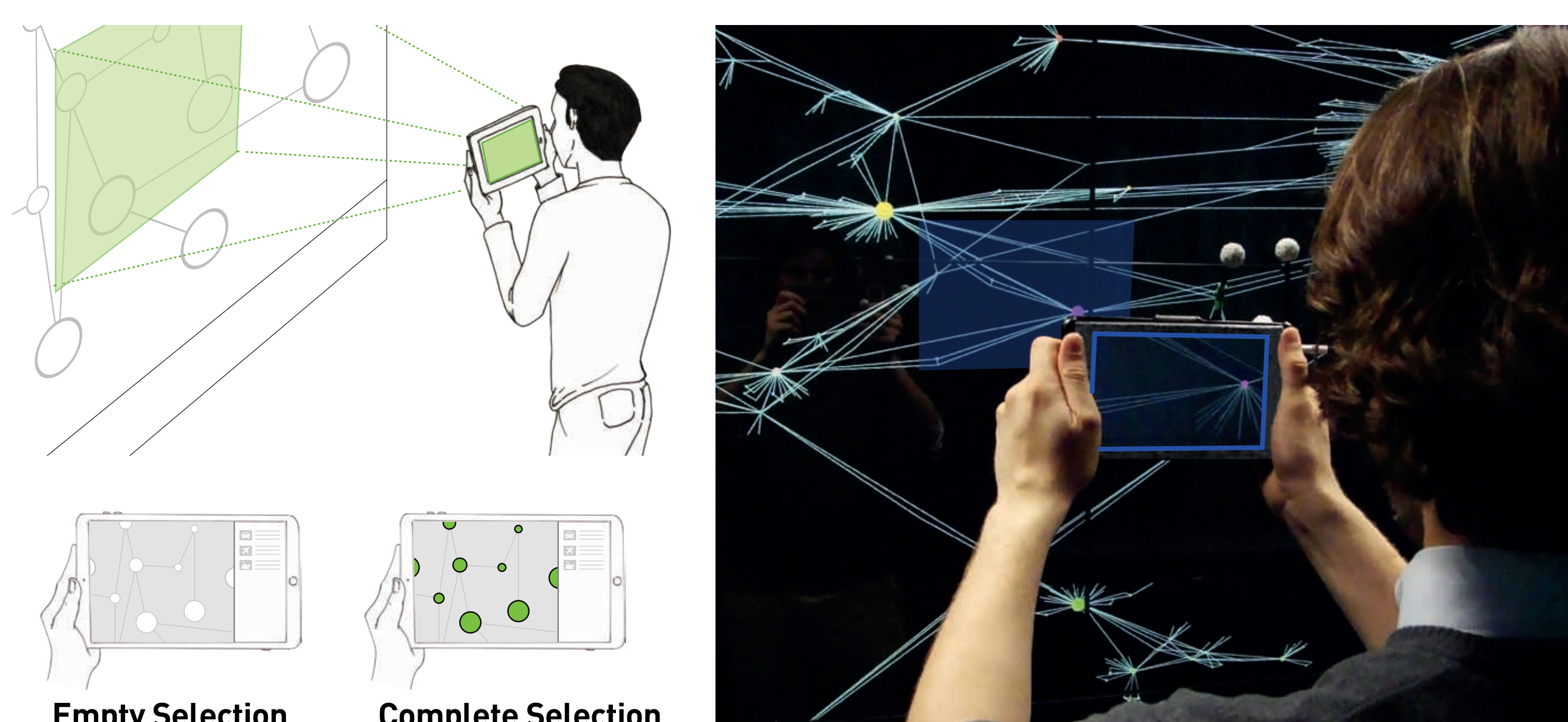
For the development of our concepts, we focus on the following design considerations:

- ▶ seamless transitions between work in contact and distant from the display wall
- ▶ support common graph tasks including select, explore, and filter
- ▶ provide alternative representations and personalized, adjusted views

Selection



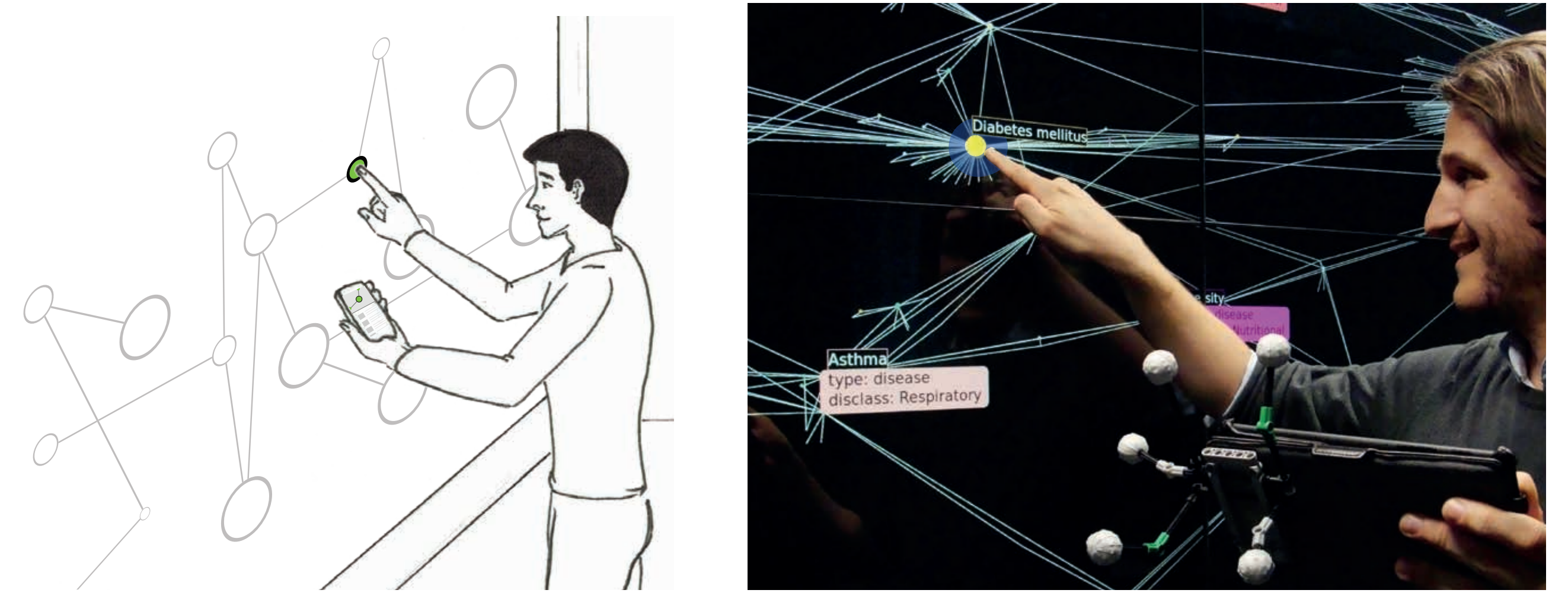
- ▶ **Encircle Nodes:** If the user encircles nodes on the wall-sized context display, the corresponding elements are transferred to the associated mobile device, which provides further exploration capabilities.



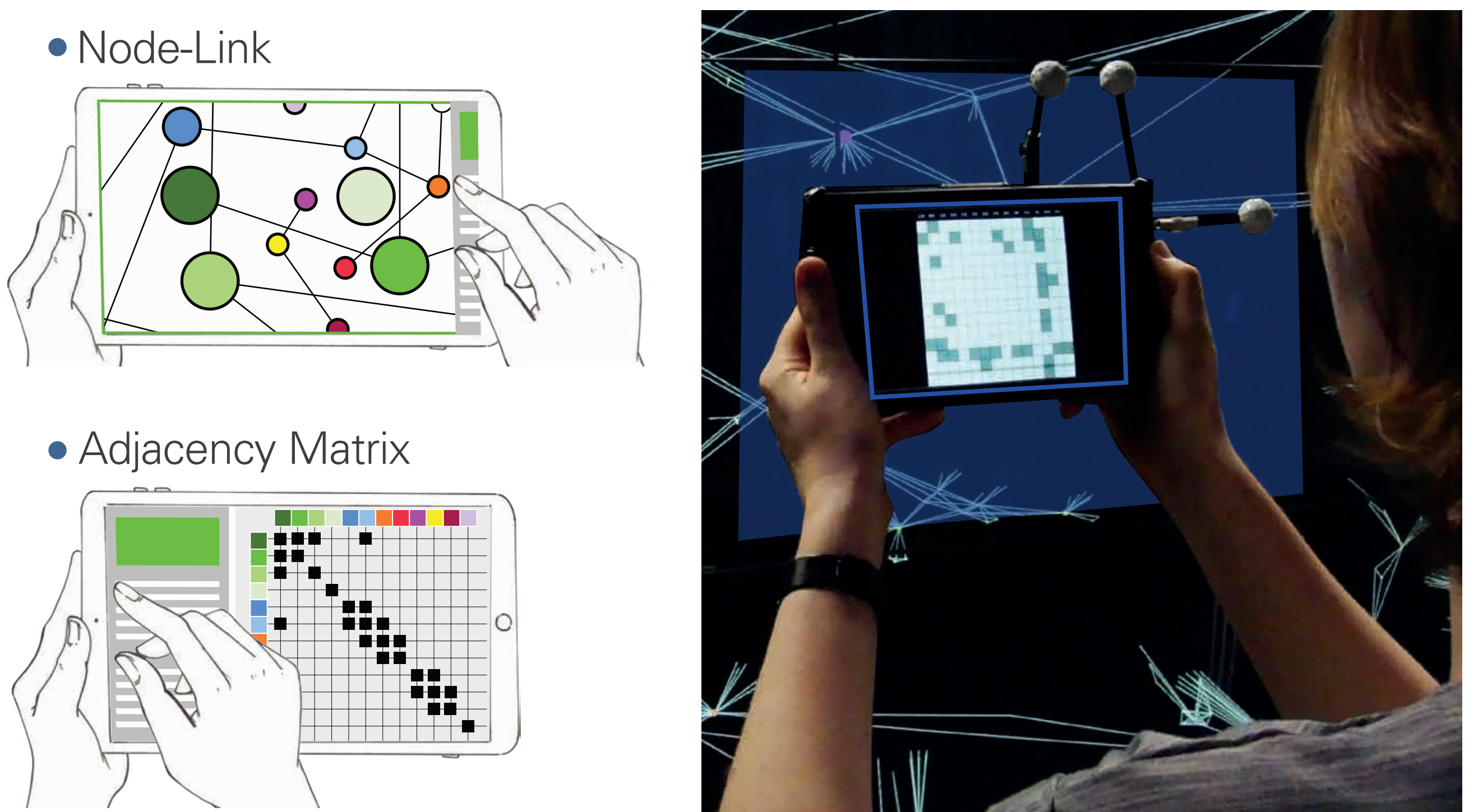
Empty Selection Complete Selection

- ▶ **Remote Pointing:** The user can move the mobile device for remote selections by spatially pointing to a section, which can later be refined.

Associated Details and Different Views

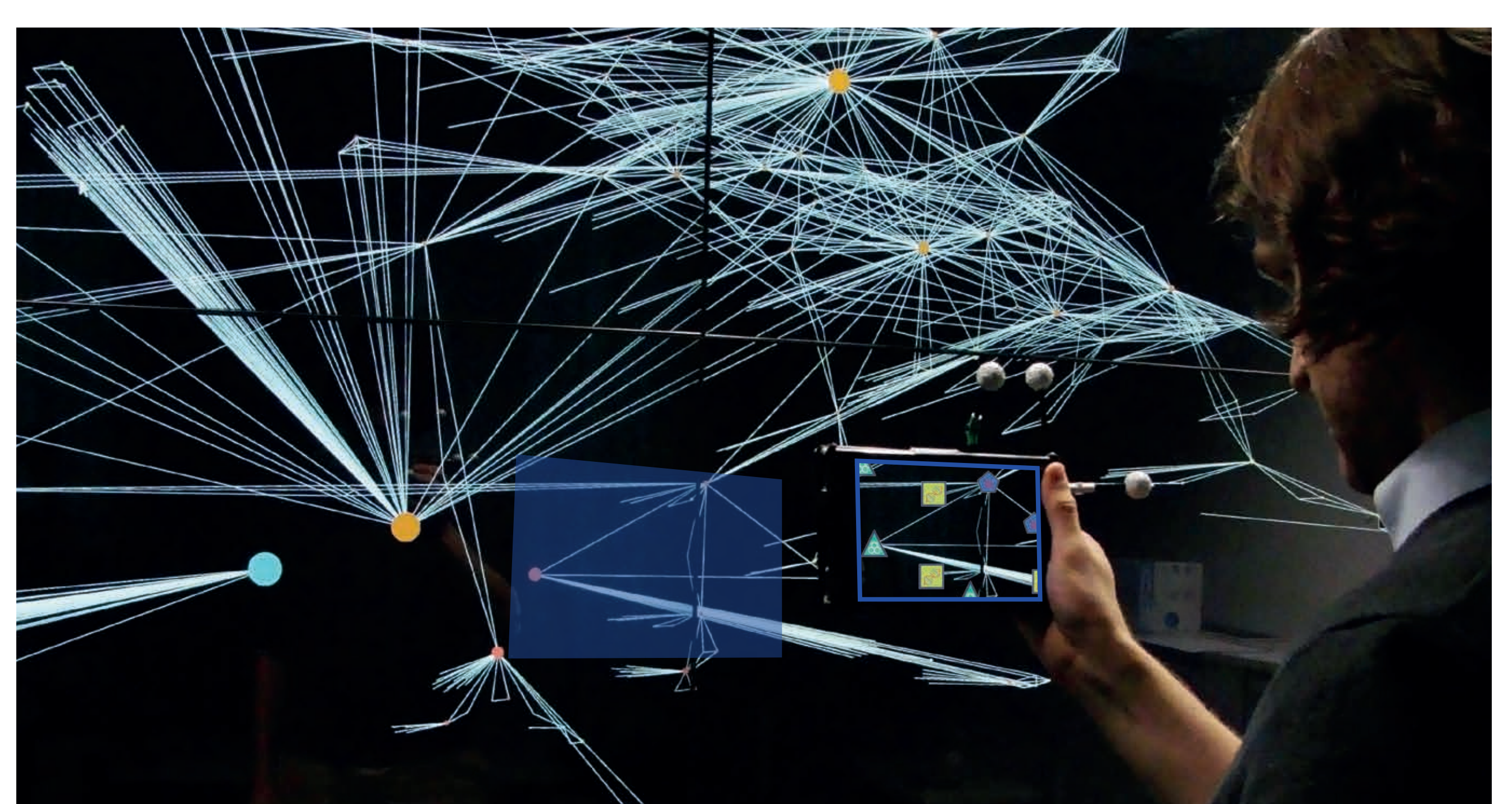
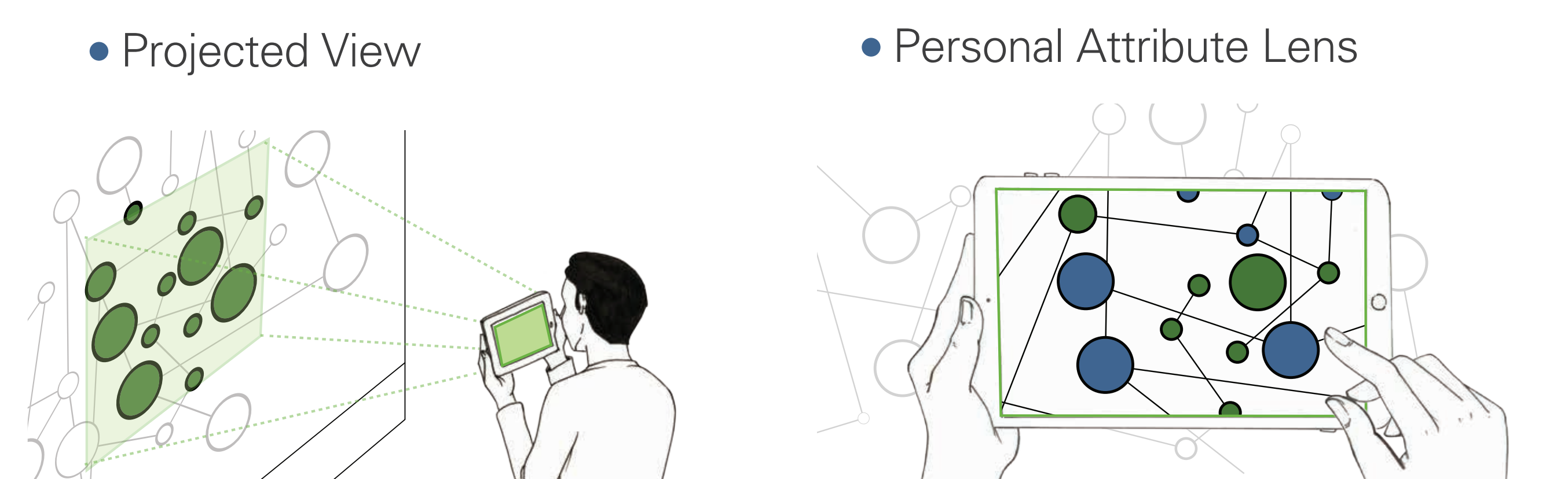


- ▶ **Associated Details:** The user can retrieve additional information by directly tapping the node of the wall-sized context display. In this case, the mobile device acts as a second, personal and high-resolution screen.



- ▶ **Different Graph Views:** Ideally, node-link and adjacency matrix representations are used in combination for graph exploration. Therefore, we use their individual advantages and seamlessly integrate these views to support several exploration tasks.

Perspective Tangible Graph Lens



- ▶ **Mobile Attribute Filter:** The mobile device can act as a personal spatially-aware graph lens. This facilitates fast explorations by combining spatially projected views using established techniques including attributes, magnification and graph specific filters.

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