

## Knowdgets: Widgets Supporting Knowledge of Interaction

**Team(s)** Loki (Centre Inria de l'Université de Lille & CRISTAL) & LII from ENAC (Toulouse)

**Level** Ph.D.

**Duration** 3 years (can start from March 2025)

**Advisor(s)** Géry Casiez, Sylvain Malacria, Damien Pollet, Stéphane Conversy [**Contact advisor(s)**]

This Ph.D. is funded by the **Knowdgets project**, which aims to redefine widgets, in what we call Knowdgets, to address the limitations of current widgets and to propose new programming approaches. The Ph.D. will be conducted in the Loki team at the University of Lille and the CRISTAL laboratory, in collaboration with the LII team at ENAC in Toulouse.

### Context

Widgets (buttons, sliders, etc.) are the building units available in toolkits to create user interfaces. They are designed to interpret users' actions (e.g. click on a button), change their graphical representation to represent their internal state (e.g. button pressed) and translate the actions into operations in an application.

As such, graphical toolkits have made it convenient for developers to assemble interfaces from pre-defined widgets, and for users to recognize these components and their behaviors. However, this convenience comes at the cost of having pre-defined widgets that constrain and limit both the interaction vocabulary the interface can support and its extensibility.

Indeed, current widgets typically support a limited set of user actions (e.g. tap and long press on a button). As a result, beyond forms, data entry and command selection, it quickly becomes necessary for developers to create custom widgets, thus giving up on the toolkit's benefits, or worse, having to bypass its limitations.

Widgets are also limiting from the end-user perspective. Indeed, the graphical representation of current widgets does not precisely convey what actions are supported (e.g. push buttons will have a similar appearance whether they only support taps or also long press). This limits the degree of discoverability of the means to interact and the bandwidth between users and interactive systems.

In the light of reactive applications and modern computing, resulting in increasingly interactive user interfaces, we argue it is now critical to rethink the very notion of widgets and untangle their responsibilities. Considering how frequently widgets are interacted with per day on e.g., a mobile phone with widget-based apps, getting rid of such limitations might improve the effectiveness, efficiency and satisfaction of millions of users. More precisely, we believe that promoting digital devices to empowering tools requires better fundamental knowledge about interaction phenomena and, in order to support this knowledge, to revisit the architecture of interactive systems.

### Objectives

The required knowledge to redefine widgets can be broken down into three types.

*Knowledge about users' capabilities.* Widgets are inevitably operated by users, users who have inherent motor, perceptual and analytic capabilities. Yet, current toolkits ignore these capabilities, thus limiting the expressiveness of interaction [1] or resulting in unexpected and unavoidable errors [5].

*Knowledge of widgets' spatial and temporal ecosystem.* Widgets typically compose a dynamically-evolving graphical interface that is more complex than the sum of its parts. Yet, they have little to no information about what is located around them, the timing of their appearance or changes, or what will be occluded by their instantiation. For example, the knowledge of the information being displayed by a widget (e.g. the duration of a video) is important to provide fine control for another widget (e.g. the navigation slider) to precisely control content (here, frame-level control) [4]. Other examples include interface changes occurring just before a motor action, e.g. when a notification appears in the foreground right as the user was about to click the close button of the rightmost web-browser tab, causing the now-misdirected click to trigger an unwanted response [5]; detecting and preventing such incidents is not possible without extending the knowledge of *when, where, and around what* a widget is about to change.

*Knowledge of how to communicate their underlying principles.* In graphical programming toolkits, each widget (push button, slider, checkbox) typically has a pre-defined graphical appearance, that has been designed with the default interaction possibilities in mind. The same graphical appearance remains, even if all interaction possibilities are not associated with an operation (e.g., when implementing an interface, a push button is generally by default clickable even if clicking on it is not associated with an operation) or if additional interactions should be supported (e.g., the appearance of a push button remains unmodified when a long-press handler is added to it, making it virtually indistinguishable from other default push buttons). This is not surprising given that most toolkits decouple the functional and visual description of the widget. Yet, updating its appearance to better communicate their underlying principles i.e., what kinds of actions are possible and how they can be carried out, is necessary [3, 2].

By following this comprehensive systems approach—encompassing human abilities, hardware elements, and all software layers above—we want at the long term to define the founding principles of future interactive systems.

The three main objectives are to:

1. Redefine the notion of atomic elements that compose GUIs to evolve beyond Widgets (Conceptual contribution)
2. Invent new control structures of Knowdget and provide programming APIs and code examples (Technical contribution)
3. Provide evidence of the benefits of the Knowdgets approach (empirical contribution)

The supervisors have recognized expertise at the international level on these topics with papers published in leading conferences of the domain. The avenues of research described above can be tailored based on preference and profile of the candidate.

## Location

The PhD candidate will join the **LOKI research group** based in the **Inria centre at the University of Lille**. Lille is at the northern tip of France and its metropolitan area, situated at the crossroads of northern continental Europe, is the 5th biggest in France. Loki is a dynamic and multicultural team with members coming from different countries (Germany, Colombia, Canada, China, Iran, France, etc.) and communicating daily in English.

## The candidate

A successful candidate must hold a MSc in Human-Computer Interaction or Computer Science, and show a great interest in performing high quality research. The candidate must demonstrate experience and strong interest in software development and HCI. Creativity, independence, team working and communication skills are valuable advantages. It is not required to speak French. A good level of technical and scientific English is also a plus. If interested in this offer, simply e-mail Géry Casiez ([gery.casiez@univ-lille.fr](mailto:gery.casiez@univ-lille.fr)) and Stéphane

Conversy ([stephane.conversy@enac.fr](mailto:stephane.conversy@enac.fr)).

## References

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