
Sensorial software evolution comprehension

Subtitle: Reinventing the World

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Dependable Distributed Systems

presented by
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under the supervision of
Prof. Student's Advisor
co-supervised by
Prof. Student's Co-Advisor

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I certify that except where due acknowledgement has been given, the work presented in this thesis is that of the author alone; the work has not been submitted previously, in whole or in part, to qualify for any other academic award; and the content of the thesis is the result of work which has been carried out since the official commencement date of the approved research program.

Gianlorenzo Occhipinti
Lugano, Yesterday July 2022

To my beloved

Someone said ...

Someone

Abstract

The comprehension of software evolution is essential for the understandability and maintainability of systems. However, the sheer quantity and complexity of the information generated during systems development make the comprehension process challenging. We present an approach, based on the concept of synesthesia (the production of a sense impression relating to one sense by stimulation of another sense), which represents the evolutionary process through an interactive visual depiction of the evolving software artifacts complemented by an auditive portrayal of the evolution. The approach is exemplified in SYN, a web application, which enables sensorial software evolution comprehension. We applied SYN on real-life systems and presented several insights and reflections.

Acknowledgements

ACK

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Chapter 1

Introduction

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Chapter 2

Related Works

2.1 History of software visualization

Essential parts of software lifecycles are software maintenance and software evolution. Both activities require the comprehension of the system by the developer. Mayrhauser [4] defined program comprehension as a process that uses knowledge to acquire new knowledge. Generally, programmers possess two types of knowledge: general knowledge and software-specific knowledge, which represent their level of understanding of that software. Software comprehension aims to increase this specific knowledge of systems, and, to do that, it can leverage some software visualization techniques. Software visualization supports the understanding of software systems because it enables the visualization of the system's information (architecture, source code, behavior) with a 2D or 3D representation. Stasko et al.[2] conducted a study in 1998 that shows how visualization arguments human memory since it works as external cognitive aid and thus, improves thinking and analysis capabilities.

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In the same year, Chuah and Erick [1] proposed three different techniques to visualize project data. They exploited the concept of glyphs, a graphical object that represents data through visual parameters. The first technique was the Timewhell glyph, used to visualize time-oriented information (number of lines of code, number of errors, number of added lines). The second technique was the 3D wheel glyph; it encoded the same attributes of the time wheel, and additionally, it used the height to encode time. Infobug glyph was the last technique, where each glyph was composed of four parts, each representing essential data of the system (time, code size, number of lines of code added/deleted/modified).



Figure 2.1. Timewhell

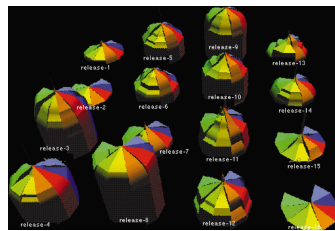


Figure 2.2. 3D wheel

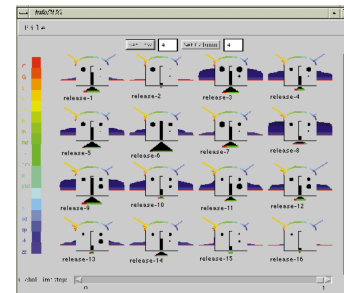


Figure 2.3. Infobug

In 2001 Lanza [3] introduced the concept of the Evolution Matrix. It was a way to visualize the evolution of software without dealing with a large amount of complex data. Furthermore, that approach was agnostic to any particular programming language. The Evolution Matrix aimed to display the evolution of classes in object-oriented software systems. Each column represented a version of the software, and each row represented a different version of the same class. The cells were filled with boxes whose size depended on two different metrics. Thanks to this approach, he was able to infer some evolution information by just looking at the shape of the matrix

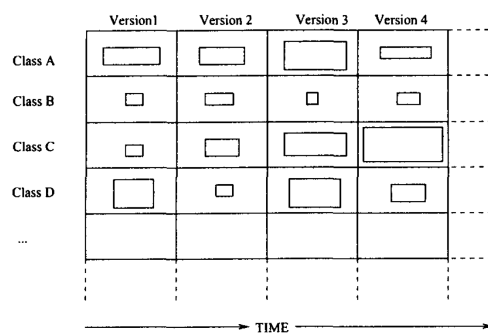


Figure 2.4. A schematic display of the Evolution Matrix

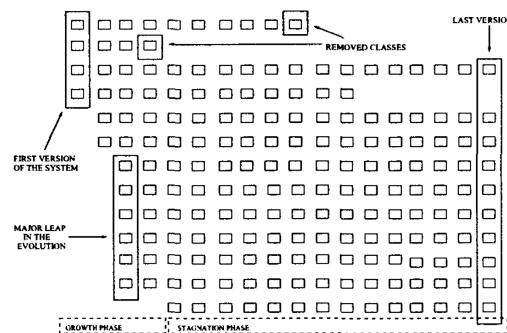
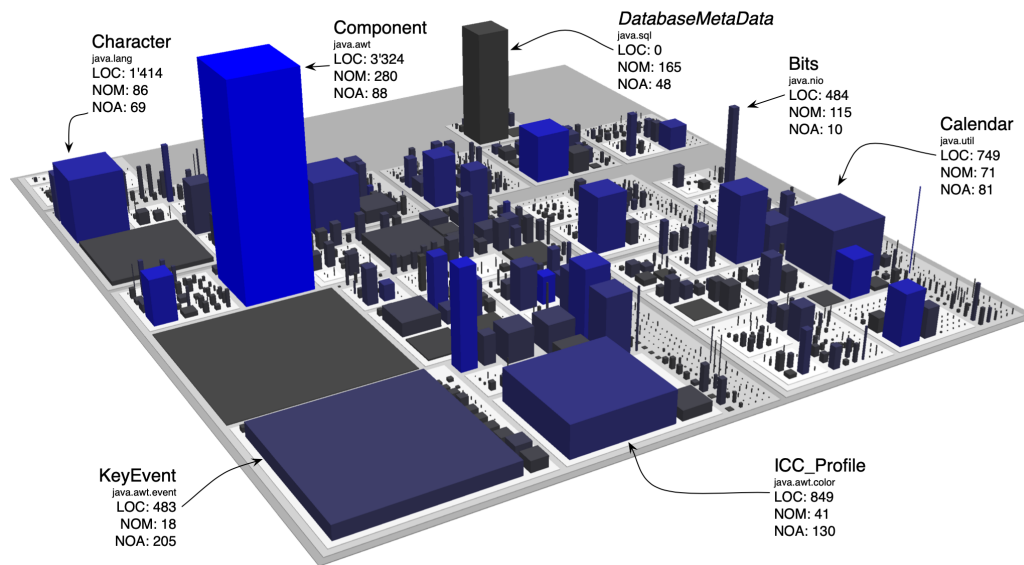


Figure 2.5. Some characteristics of the Evolution Matrix

Wettel in his thesis [5], defined a city metaphor for software visualization that represents software as cities. His work represents packages as districts and classes as buildings. This metaphor was applied in different contexts related to reverse engineering (program comprehension, software evolution, software quality) to demonstrate metaphor's versatility. As a result, he found evidence that his approach works. However, he claims that city metaphor brings visual and layout limitations (not all visualization techniques fit well with it). Under those circumstances, he preferred simplicity over the accuracy, so he obtained a simple visual language that facilitates comprehension of data. He conducted an experiment of the evidence that the city metaphor enables the creation of efficient software visualizations. His approach was implemented by a software visualization tool called CodeCity that supports the city metaphor.



Appendix A

Some retarded material

A.1 It's over. . .

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