Bachelor project 2019 / 2020

Continue sketching! Intelligent infrastructure to digitize, crop, and categorize design sketches

System Analysis and Modeling Research Group, Prof. Dr. Holger Giese

Scenario

Designers express complex ideas by drawing, writing, and adding Post-its to a whiteboard. This happens over various design sessions that can take from a few minutes to a couple of hours each.

However, after the design session is over, designers face many difficulties to continue working.

- They need to store the material and protect it from inadvertent removal
- They cannot easily reuse their sketches in a new design session
- They must rely on pictures that potentially contain a lot of overhead, to share even simple ideas with others.
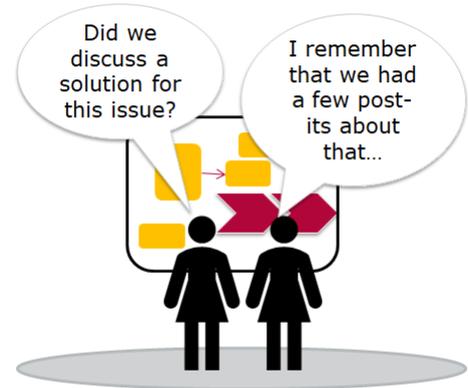
In the face of that, we propose to develop a solution to facilitate the reuse of whiteboard pictures.

Figure 1 Need for sketch reuse

Challenges

Reusing whiteboard pictures poses a set of challenges:
- How to capture whiteboard images so that relevant sections are easy to identify and crop?
- How can digital prototypes and sketches be included into this process?
- How to automatically cluster the contents of a sketch (Post-its, arrows, words, drawings)?
- How to categorize individual sketches by shape, written contents and proximity to other sketches?

Solution

We plan to build a knowledge base that can be quickly populated with individual sketches, which can easily be reused in later design sessions. The solution requires that the pictures are automatically cropped to yield individual sketches (e.g., Post-its, drawings, words) that must be stored in a convenient way. These sketches will be retrieved by their keywords and their proximity to other sketches. In all these steps we plan to use out-of-the-box graph database tools and image and text recognition algorithms.
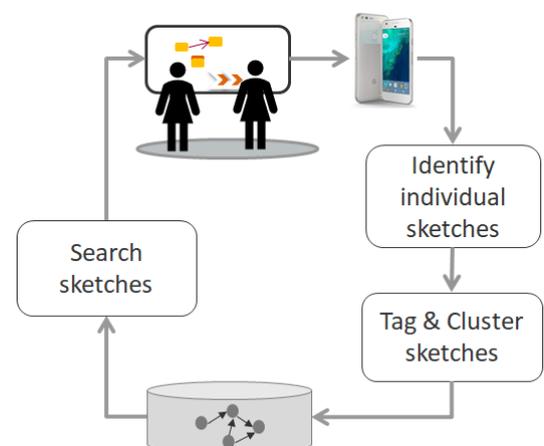

Figure 2 Solution components

Project Objectives

The goal of this project is to build a prototype of the envisioned solution, for which the following **components** must be designed and built:

- **Digitizer** is an enhanced camera app to capture the whiteboard images. The app could add metadata to the picture or automatically apply contrasts to facilitate later image cropping.
- **Automatic identifier** is a machine learning component that automatically crops individual sketches in the picture of a whiteboard. The idea is to reuse existing algorithms that detect shapes and words.
- **Automatic classifier** is a machine learning component that will label the sketches by their corresponding shapes and words. It will also capture the information about which sketches were in the vicinity of each other.
- **Knowledge-base** structures the sketches from previous design sessions in a graph database.
- **Querying by keyword and relationships** will enable users to query in SQL or Cypher format (Graph Database), e.g., "show me the architecture sketch that we talked about last week and that was connected to the user needs sketch".

In order to implement these components, we recommend following **technologies and methods**:

- App development frameworks (e.g. Ionic, JQuery Mobile, React native)
- Image and Text recognition algorithms (Neural nets)
- Distance metrics (DCC, Cosine similarity, Jaccard)
- Graph database (Neo4J)
- Unsupervised learning methods (K-means, Generative adversarial nets)

Project Organization

During this bachelor project, the student team should apply agile methods, which will involve short delivery cycles guided by the concept of MVP (minimum viable product). There will be regular meetings with the project supervisors and additional coaching and support whenever needed. The student team will have a free choice of tools, development processes and technologies based on their prior experience. It is possible, but not mandatory, to reuse component from last year's bachelor project[1]. Students will acquire insights and experiences on new technologies (graph and document database) and new methods (agile, machine learning).

Project contacts

This bachelor project is offered by the System Analysis and Modeling group of Professor Giese. Christian Adriano and Christian Zöllner will be the main coaches and supervisors. Our external project partner is the HPI School of Design Thinking represented by Dr. Claudia Nicolai, Sherif Osman and Stefanie Gerken. The D-School team will be available for project scoping, interviews and feedback sessions, will provide datasets and is interested in the use of the outcome.

If you have any further questions, please contact Christian Adriano and Christian Zöllner (room: A-2.7, e-mail: christian.adriano@hpi.de and christian.zollner@hpi.de) and feel free to visit our current bachelor project (room: A-2.3).

---

[1] The previous bachelor project dealt with voice-based search of whiteboard sketches. Components that could be reused include a database of sketches, machine learning models for categorization and recommendation systems for of images. In addition, several bachelor theses explored features that are closely related to this year's project and can serve as a starting point.