

Enhancing UML Sketch Tools with Digital Pens and Paper

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Motivation and Approach

Digital sketch-based UML tools try to support sketching with Tablet PCs or electronic whiteboards. These devices prevent spontaneous sketching because:

- They are expensive and not always available
- They need power supply
- It takes time to start them up

Our approach We propose to use digital pens and paper in combination with digital sketch-based diagram tools. Users can work like with common paper, with the advantages of digital features available at the same time.

Digital Pens and Paper

Our approach is based on the Anoto functionality. The digital pens capture the Anoto dot pattern, which is printed almost invisibly on the paper. Every snapshot delivers sufficient information to determine the absolute position of the pen and what the user has written or drawn.

There are three ways to transfer data from the pen to an application:

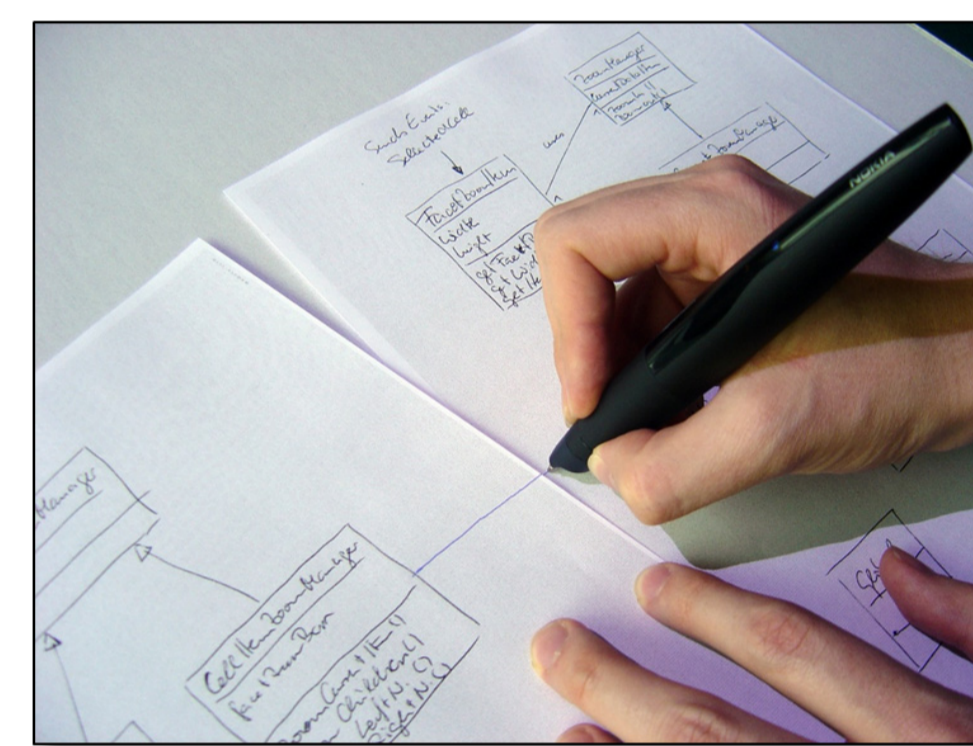
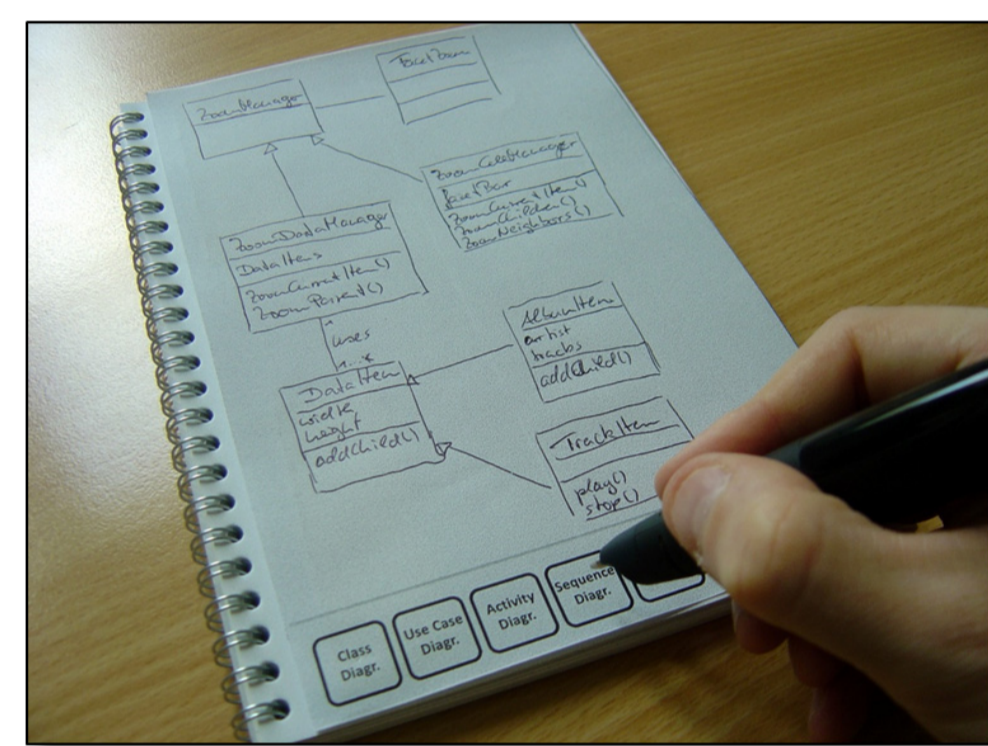
- Putting the pen in a docking station
- Tapping on boxes printed on the page to initialize Bluetooth transfer
- Streaming immediately via Bluetooth

UML Sketching with Digital Pens and Paper

Sheets or notepads printed with Anoto pattern can be used to draw diagrams. The drawn content is transferred to an application, where the sketches are converted to formal UML diagrams.

UML sketch books

Boxes at the bottom of each page represent different diagram types. Tapping on the respective box assigns a certain meaning to the drawn diagram and supports a proper recognition.



Single sheets of paper

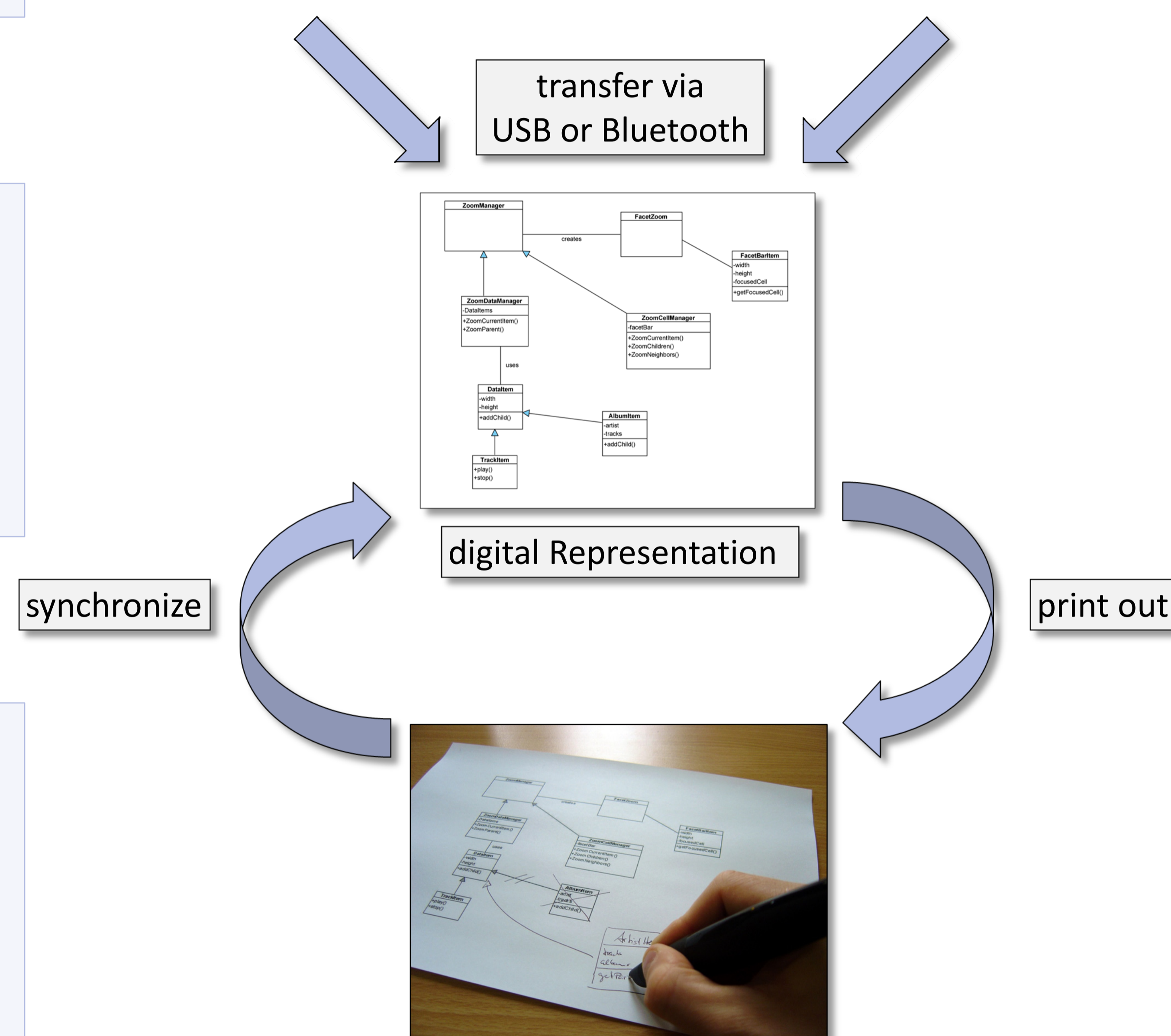
Connections between elements can be drawn across different sheets and solve the problem of lacking space. This approach can be especially beneficial for collaborative settings.

Recognition engine

The application interprets the content as UML diagrams including handwriting. Parts not recognized stay as sketches. It can also visualize how strokes were drawn one by one

Editing of printouts

Digital diagrams can be printed on Anoto-enabled paper. Changes made by drawing new elements or crossing out existing elements are recognized by the system and can be synchronized automatically.

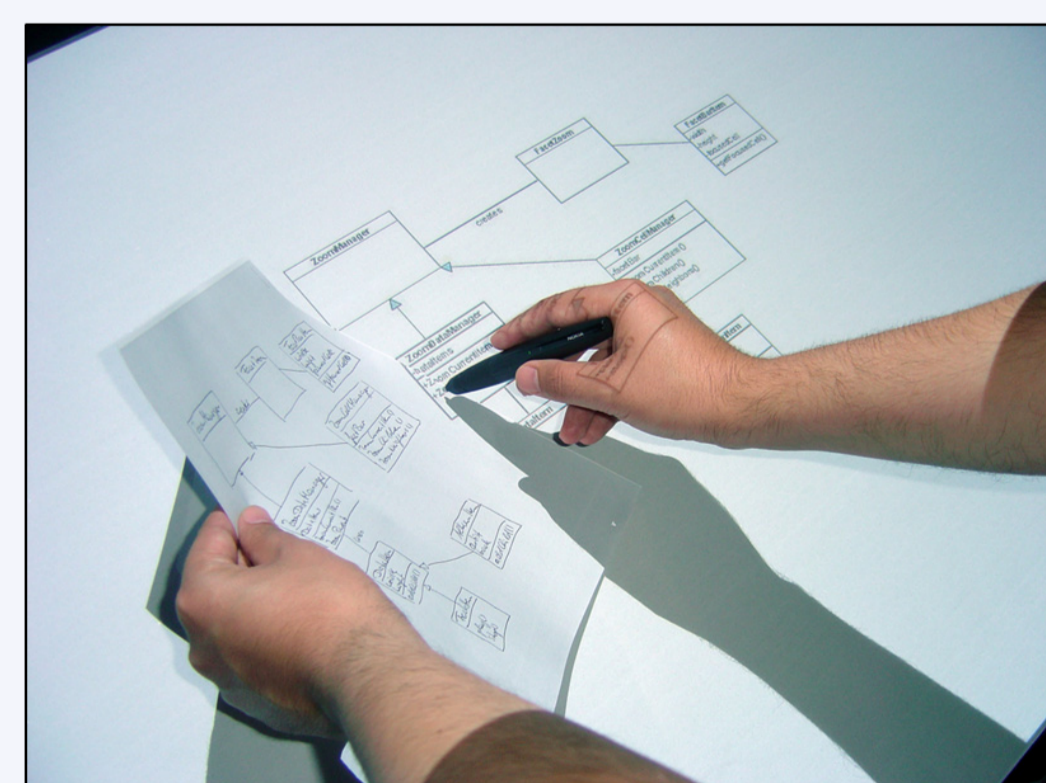


Paper and Interactive Surfaces

We use the Anoto functionality also for multi-pen enabled tabletop displays. The pattern is located underneath its surface; thus it is possible to draw like on whiteboards.

Seamless Transition

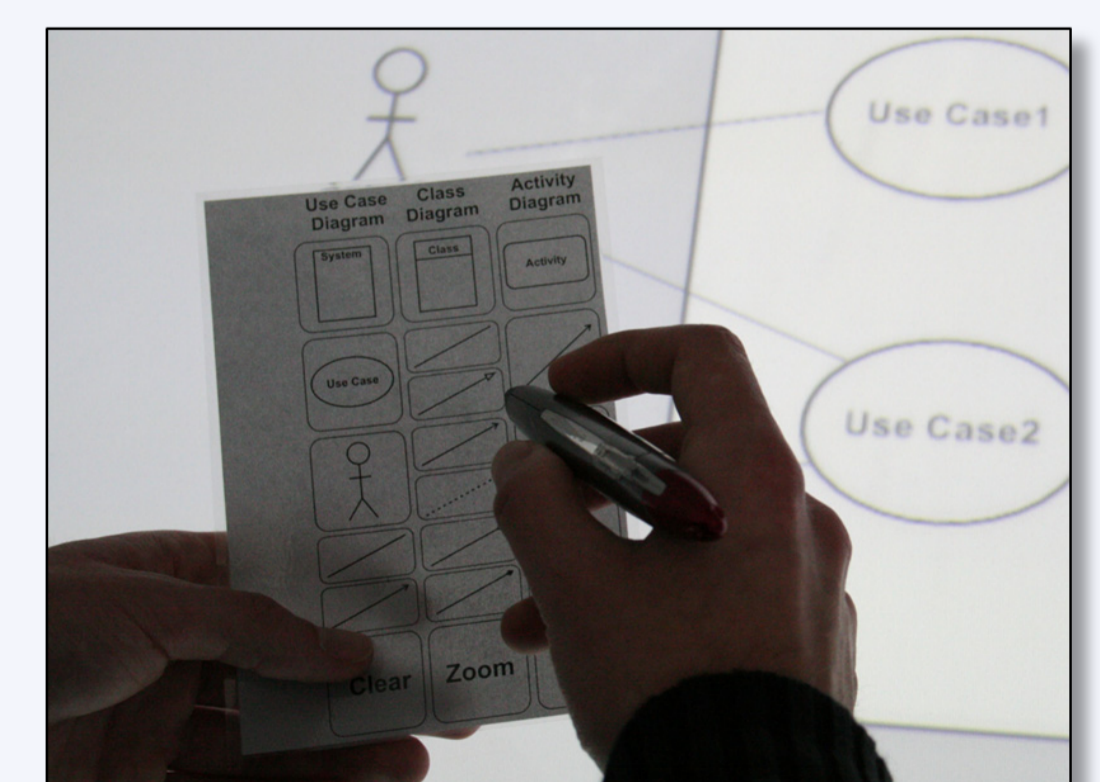
Sketched content can be seamlessly dragged from the paper to a display.



UML-Palettes

UML elements are printed on Anoto-enabled paper. By tapping on an element, it is "picked up" and can be placed on the display

- Supports creation of formal diagrams
- Can serve as a memory aid
- Can be combined with sketching



Prototypes

- UML-palette application enables multiple users to tap on UML elements on the palette and place them on the tabletop
- Sketch recognition software can recognize rectangles, ellipses and connections, which are drawn directly or transferred from a digital pen

Future Work

- Integration of the prototypes and assignment of semantics to UML elements
- Test of different UML-palette designs
- User studies concerning speed, accuracy and user experience

