A proposal for the recognition of handwritten SignWriting for SWORD project

Fabrizio Borgia[1,2], Maria De Marsico[2]

[1] Université Toulouse III - Paul Sabatier
[2] Sapienza Università di Roma

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Introduction

- A pencil and a piece of paper are the only required items to produce signs using SignWriting

- Since the early years the need to produce a digital version of the system was evident

- The informatization of the system, started in 1986 with the SignWriter computer program, allowed SignWriting to achieve a wider diffusion through:
  - Newspaper
  - Books
  - Websites
  - Other digital resources

+ Introduction

- Digital version of the <u>glyphs</u> were created

- The conceptual organization of glyph images was ensured by assigning to each of them a unique ISWA code

Introduction

- SignWriting digital editors are the tools that enable the creation of digital resources written in SignWriting

- In other words, they are critical for the informatization of SignWriting and therefore the "digital transcription" of SLs

- Many applications have been produced by different teams, delivered in different ways, ranging from desktop to web applications

+ Introduction

- Most SignWriting digital editors basically provide the same functionalities

- Despite differences in design and implementation existing from one editor to another, such functionalities are:
  - Search for (or type) glyphs which belong to the ISWA
  - Insert the chosen glyphs onto an area which is designated for the composition of the sign
  - Manage the glyphs on the sign composition area
  - Save the sign in one (or more) formats
  - See SignMaker and SWift

Introduction

Despite their increasing capabilities, SignWriting digital editors are still far from the simplicity of the handwriting approach.

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Introduction

- Any SignWriting digital editor developed so far relies heavily on "Windows, Icons, Menus, Pointer" (WIMP) interfaces

- They require a navigation/selection process in a huge amount of digital images that, though facilitated, may become long and cumbersome

- SignWriting users are more fast and comfortable when using handwriting, rather than when dealing with the complex interaction style of a SignWriting digital editor

- Writing is easier than undestranding and using a User Interface

The SWORD project

SignWriting Oriented Resources for the Deaf (SWORD)

- A project towards the full SignWriting-based integration of deaf people in the digital society

- The project aims at producing digital artifacts (applications, websites, etc.) featuring deaf-oriented accessibility via written Sign Language

- A SignWriting digital editor, namely SWift, was produced within SWORD

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A new generation of SignWriting editors

SWift still carries most intrinsic shortcomings of its peers, including the strict dependency on WIMP interfaces.

SW-OGR
Concept

We designed a new generation of SignWriting editors, able to partially overcome the concept of the WIMP interface and to move along the line of the so called "natural interfaces".

- No click, drag, search and browse on the UI during the SW production process

SW-OGR Concept

- Introducing a SW-OGR engine within an existing SW editor, such as SWift:
  - The user will handwrite glyphs rather than searching them among thousands others
  - Each handwritten symbol will be processed and replaced with its standard ISWA version by SW-OGR

- We maintain the advantages of a digital editor
  - Multiple save options: PNG, XML and remove save
  - Each sign is save in a database with the list of its component glyphs: support for linguistic analysis

SW-OGR
Challenges

- WIMP is currently the most common interface style, it cannot be totally left behind
  - The interaction with most application is still firmly grounded on it

- Nevertheless, our aim is to limit its use, or to dismiss it whenever possible, during the SW production process

SW-OGR
Challenges

- Very high number of glyphs (tens of thousands)

- Multilinear/two-dimensional arrangement

- No rigid rules for composition

- Complex segmentation, particularly when handwritten

- OCR-like pattern-recognition approach not feasible
  - Large amount of patterns to recognize, and consequently very long machine training

SW-OGR
Design

SignWriting Optical Glyph Recognition (SW-OGR)

An application module designed to operate the electronic conversion (recognition) of user-produced images containing handwritten (or printed) SignWriting symbols into machine-encoded (ISWA) SW text.
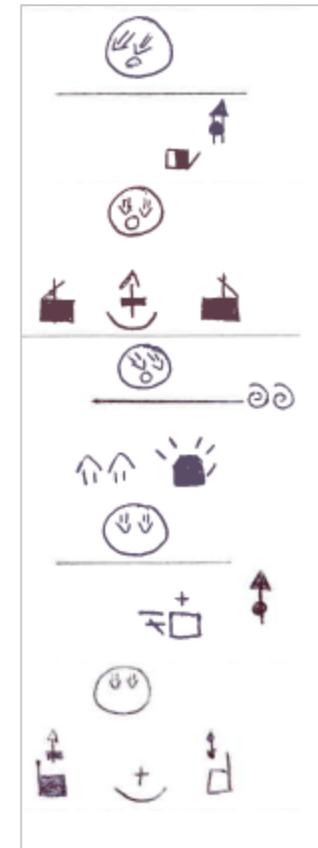
SW-OGR
Design

- The SW-OGR approach is based on:
  - Geometric features of the glyphs
  - Topologic information about the glyphs
  - Contextual information about the organization of the ISWA

SW-OGR
Design
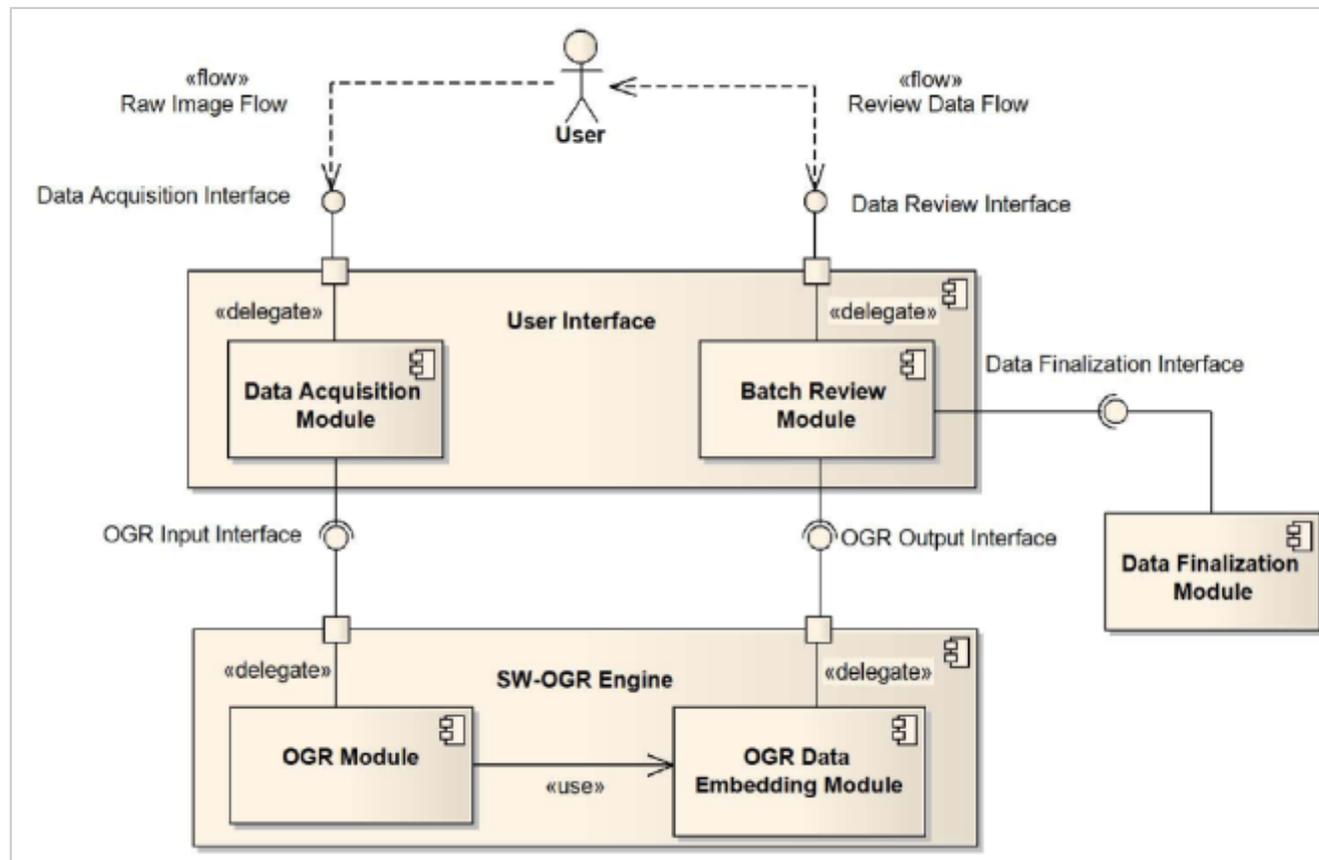
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SW-OGR
Design

Image (SignWriting text) production by the User

Image acquisition interface
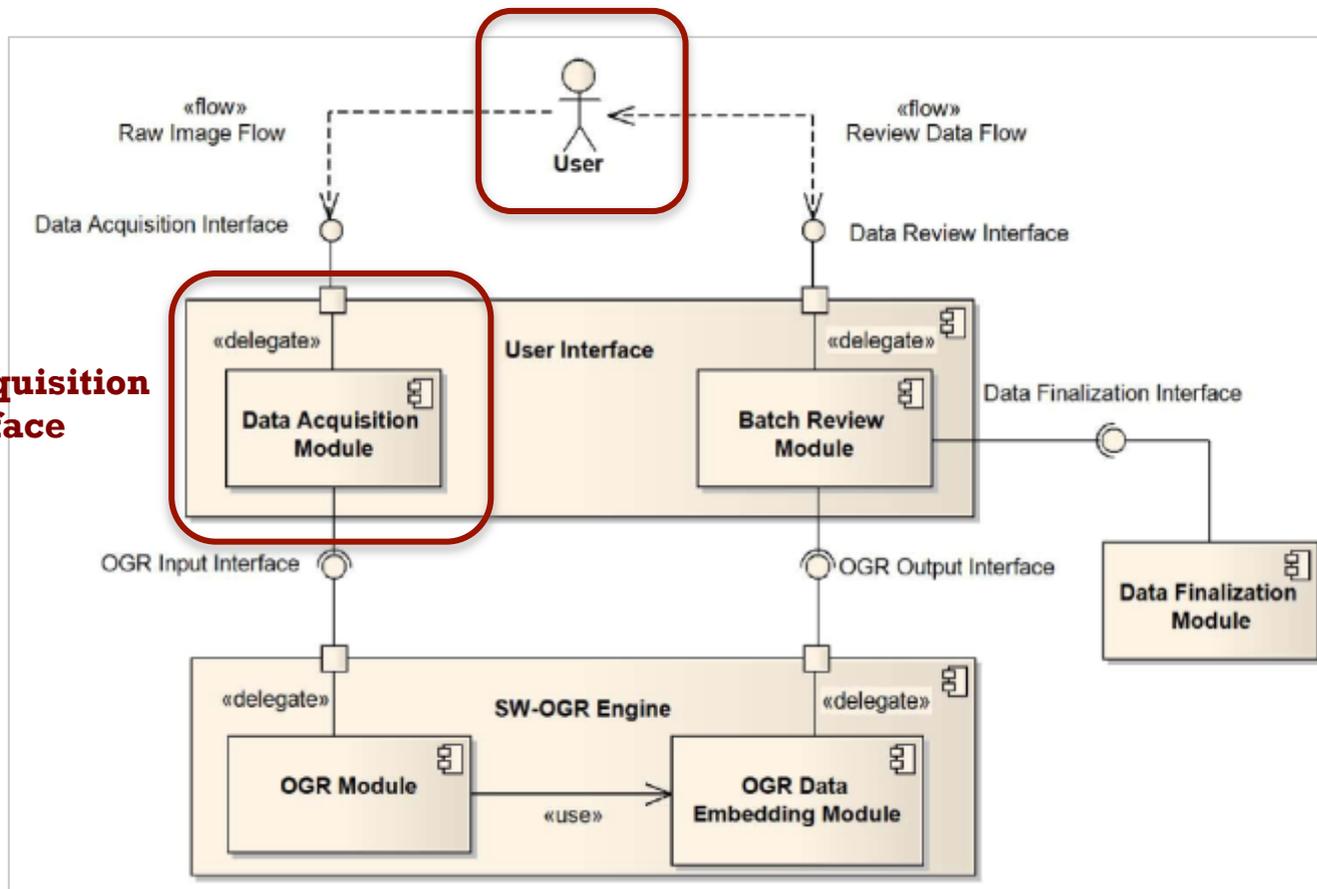
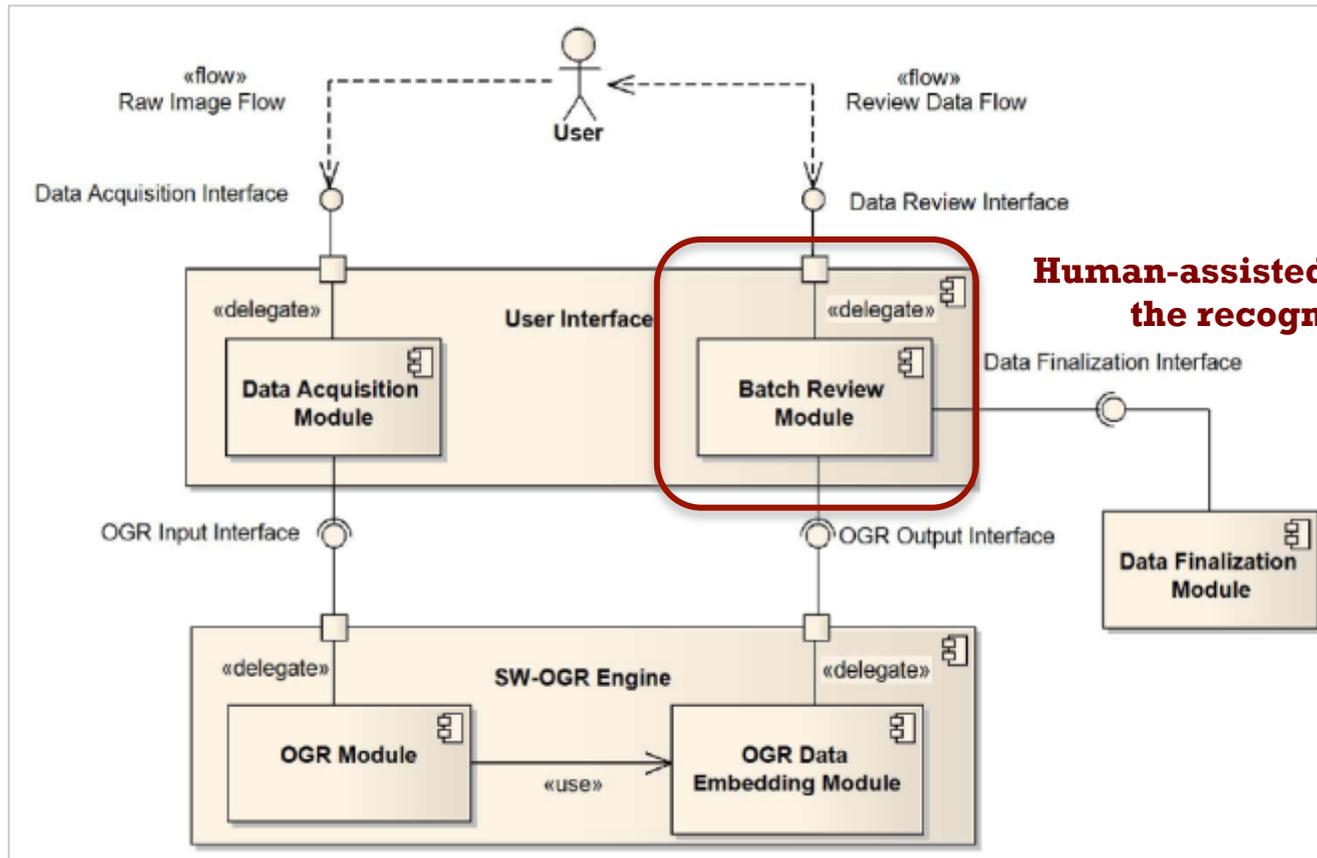A proposal for the recognition of handwritten SignWriting for SWORD project
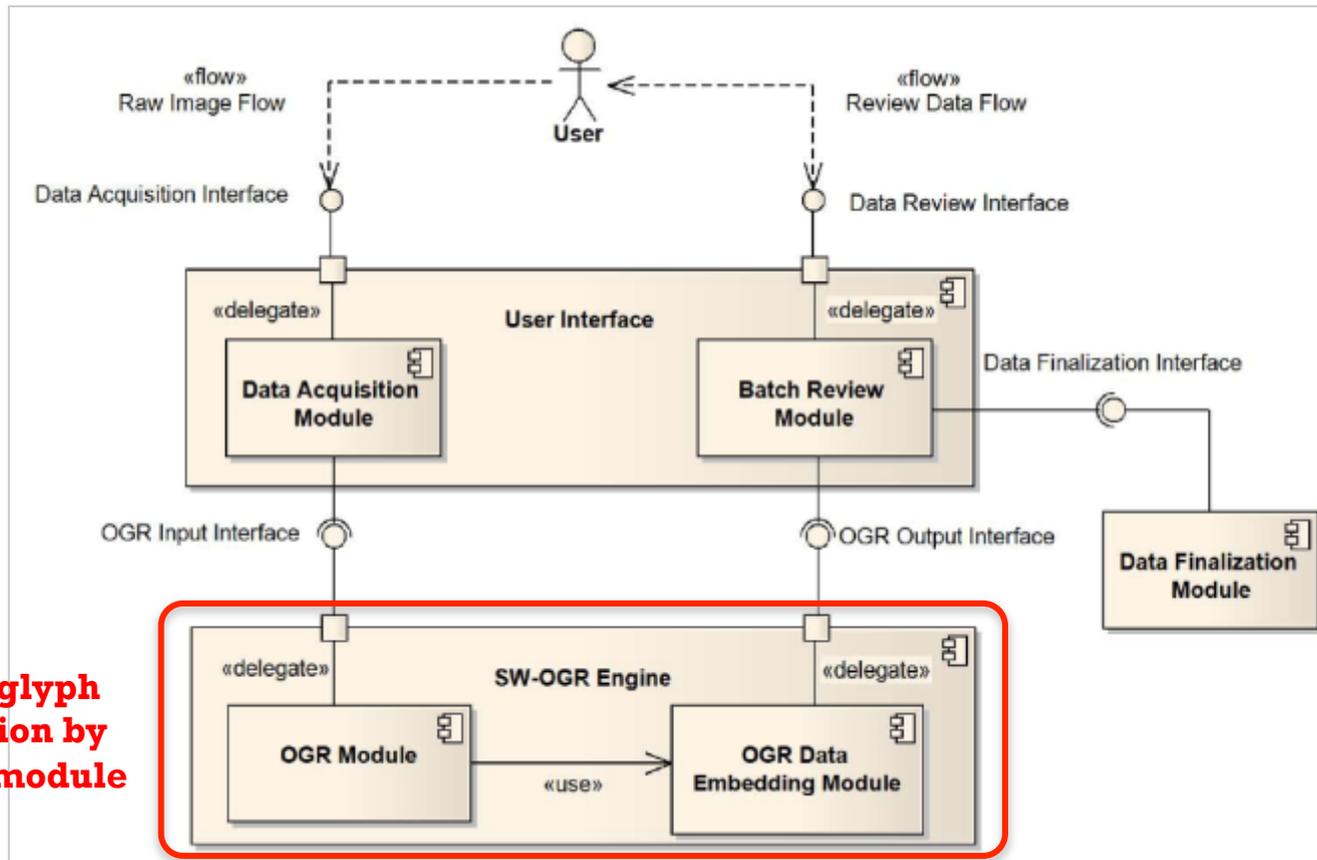
SW-OGR
Design

Optical glyph recognition by SW-OGR module

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SW-OGR
Design

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SW-OGR
Design

- The recognition by SW-OGR is composed by different analyses of the image (SignWriting text):

1. Image pre-processing and binarization
   - Noise reduction, thresholding
2. Detection of geometric shapes within the image
   - Circles, rectangles, trapeziuses, etc...
3. Category inference on geometric shapes
   - Topological and contextual information
4. Glyph recognition
   - OGR coding to ISWA coding conversion

+ SW-OGR
Design

- OGR Coding
  - An alternative coding for SignWriting symbols able to guide the recognition process
  - Only takes into account geometric/topoligical features of the glyphs
  - It does not substitute ISWA: it is a "process coding"

- OGR Coding of a handwritten glyph can be automatically calculated by SW-OGR

- OGR to ISWA mapping tables are required to complete the recognition

- ISWA Bianchini was employed for the conversion, but the recognition output can also be encoded in ISWA 2010

SW-OGR
Design
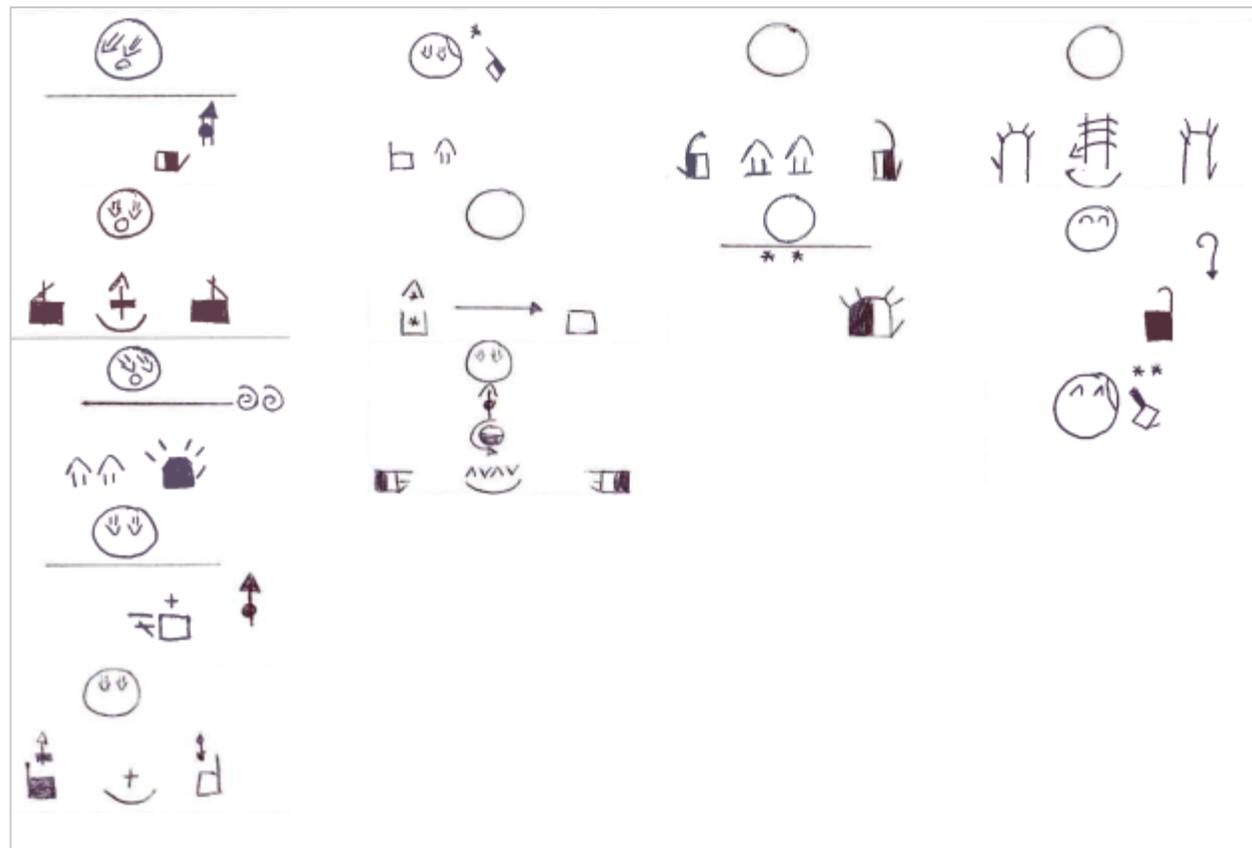
- OGR to ISWA mapping table

ISWA Bianchini codes   **OGR codes**

4	09021-02-00000-0000-a	1.2.0.0.4.*
5	09021-02-00000-0000-a	1.2.4.0.4.*
6	09021-02-00000-0000-a	1.2.4.1.*.*
7	09021-05-00000-0000-a	1.2.0.3.*.*
8	09021-05-00000-0000-a	1.2.0.0.2.*
9	09021-05-00000-0000-a	1.2.4.0.2.*
10	09021-05-00000-0000-a	1.2.4.3.*.*
11	09022-02-00000-0000-a	1.4.0.0.*.*
12	09022-03-00000-0000-a	1.4.0.0.*.*
13	09024-04-00000-2000-a	2.1.0.4.0.1
14	09024-04-00000-1000-a	2.1.0.4.0.2
15	09021-01-00000-0000-a	2.2.0.0.*.*
16	09021-01-00000-0000-a	2.2.0.4.4.*
17	09021-01-00000-0000-a	2.2.4.0.*.*
18	09021-01-00000-0000-a	2.2.4.4.4.*
19	09021-04-00000-0000-a	2.2.0.1.*.*
20	09021-04-00000-0000-a	2.2.4.1.*.*
21	09021-03-00000-0000-a	2.2.0.3.*.*
22	09021-03-00000-0000-a	2.2.4.3.*.*
23	09022-01-00000-0000-a	2.2.0.4.*.*
24	09022-01-00000-0000-a	2.2.4.4.4.*
25	09024-01-00000-2000-a	2.2.2.2.4.1
26	09024-01-00000-2000-a	2.2.1.0.4.1
27	09024-01-00000-2000-a	2.2.1.2.4.1
28	09024-01-00000-2000-a	2.2.2.0.4.1
29	09024-05-00000-2000-a	2.2.2.2.4.1

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SW-OGR
In action

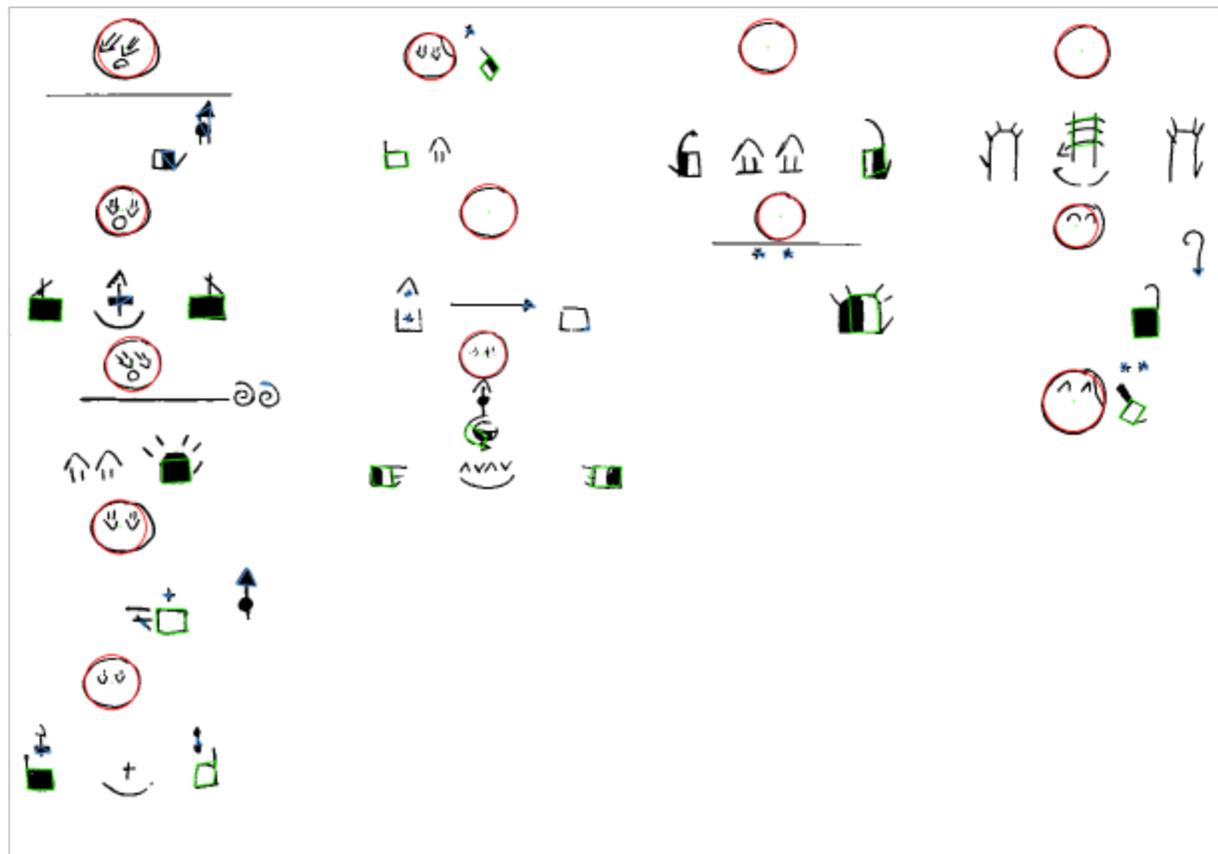Image pre-processing and binarization

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SW-OGR
In action

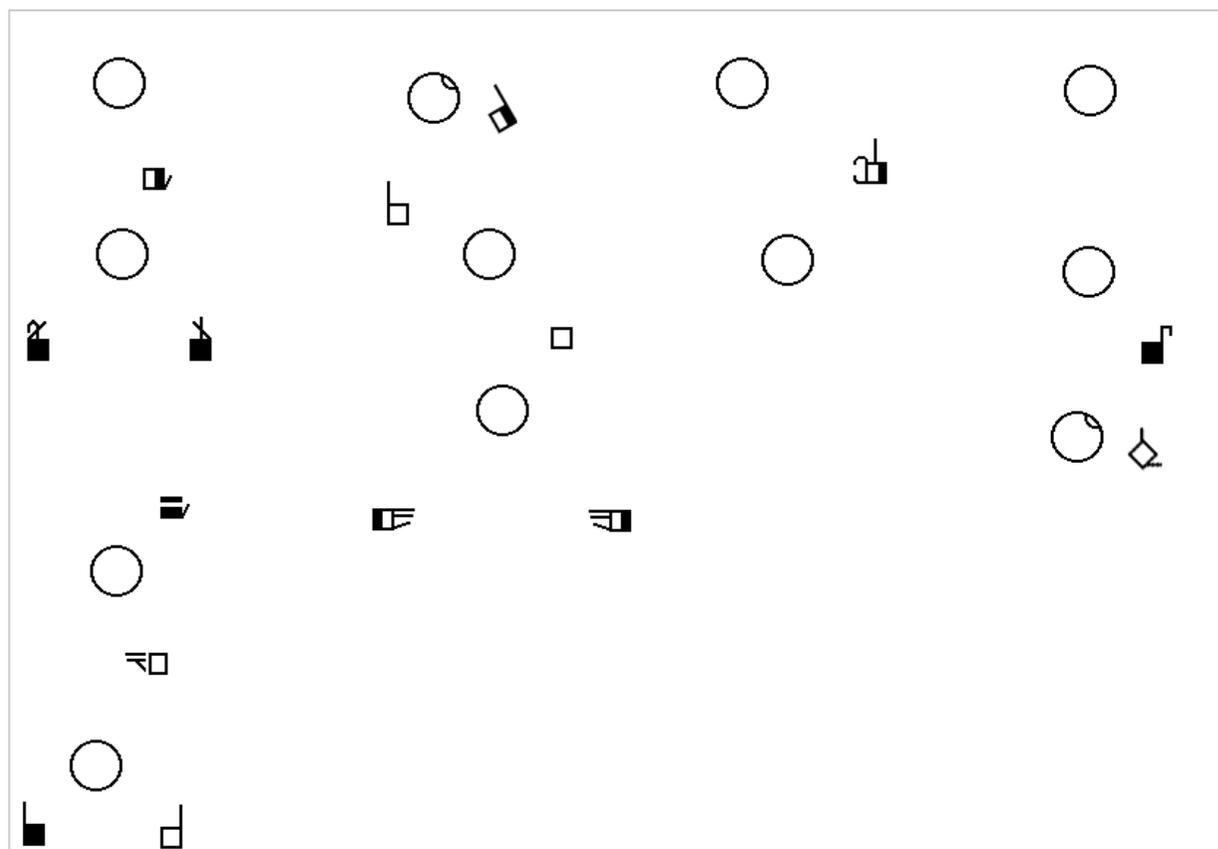Detection of geometric shapes within the image

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SW-OGR
In action

Recognition output (in development)

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+ Conclusions and Future

"IT... COULD... WORK!"

(Dr. Frederick Frankenstein)

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Conclusions and Future

- SignWriting Optical Glyph Recognition is possible

- SW-OGR makes digital handwriting of SignWriting texts real

- Overcoming WIMP interface in digital editors will make the sign composition process real

- SW-OGR needs to be expanded adding support for more and more ISWA categories and groups

- Real-time text recognition and batch corpora digitalization

- Next step: transcription from videos