

Towards Improving the e-learning Experience for Deaf Students: e-LUX

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+ Outline

- Introduction
- Accessibility and e-learning experience
- E-Learning User Experience
- Vocal Language and Sign Language
- Sign Language inclusion techniques
 - Videos
 - Written SL
- SignWriting
 - Supporting accessibility with SignWriting
 - Integration example: SWift
 - SignWriting Optical Glyph Recognition (SW-OGR)
- Conclusion

+ Introduction



- Deafness is a sensorial impairment, not a mental one.
- Accessibility for deaf people is still not sufficiently addressed
- Misbelief: it is enough to substitute sound/voice with text
- Deaf people experience difficulties with vocal (spoken/written) languages due to a different cognitive organization of linguistic structures, and not for general cognitive difficulties



+ Accessibility and e-learning experience



Accessibility has always been considered as one of the constituent facets of user experience.

“ *It is not just an additional feature, it is a core component that makes modern interfaces complete. If designers fail to pay attention to the design needs for a small percentage of the population, they ultimately fail on a global scale.* ”

Y. So and L. Veneziano - Designing for Experience: The Role of Accessibility in Service Design



+ Accessibility and e-learning experience

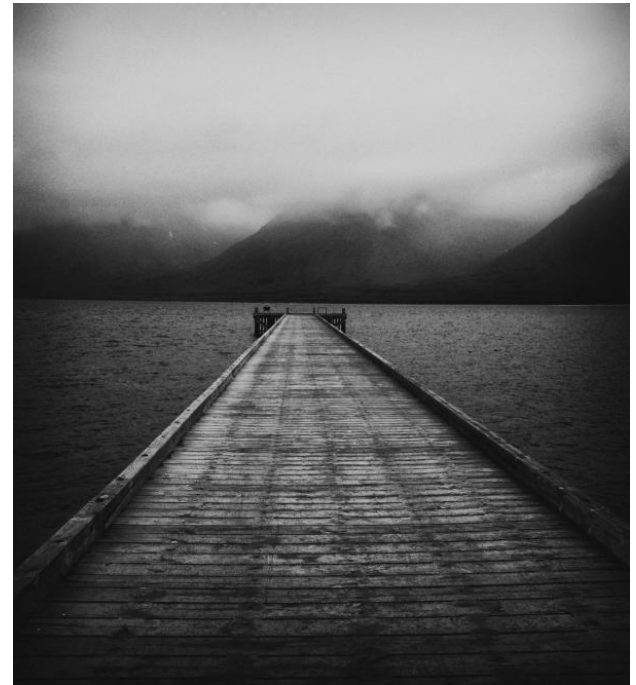
Due to their educational purposes, the usability and accessibility of e-learning applications are especially important.

- Design both container and content.
- Exploit a multi-disciplinary range of competences.
- Employ subjects belonging to the target categories of users.



+ E-Learning User Experience (e-LUX)

- Avoid “gulfs of execution” between:
 - the user and the container
 - the user and the content



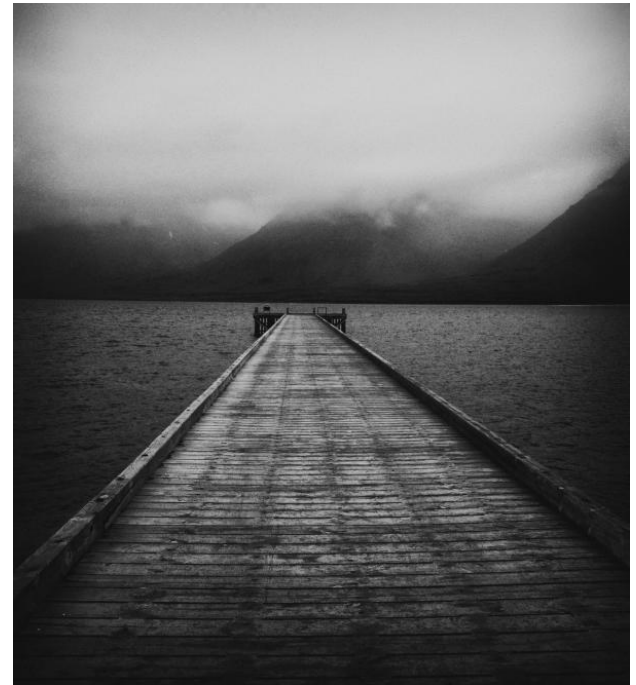
+ E-Learning User Experience (e-LUX)

“ *The **gulf of execution** is the degree to which the interaction possibilities of an artifact, a computer system or likewise correspond to the intentions of the person and what that person perceives is possible to do with the artifact/application/etc.* ”

D. Norman - The Design of Everyday Things

+ E-Learning User Experience (e-LUX)

- Avoid “gulfs of execution” between:
 - the user and the container
 - the user and the content
- LESS time understanding the container
MORE time working with the content
- Proficiency and motivations may be heavily affected by a cumbersome UX



+ E-Learning User Experience (e-LUX)

- Learners with special needs are especially exposed to digital divide and frustration
- Learners with special needs may present a special attitude to consider themselves/be considered as guilty for possible failures
- In most cases, it is only a matter of finding the right UX strategies



+ Vocal Language and Sign Language

Vocal Language and Sign Language have different structures

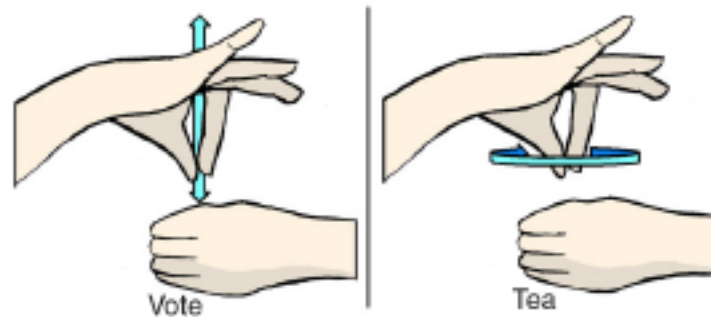
- Vocal Language (VL)
 - Linear and sequential structure.
 - Embodiment is very rare
- Sign Language (SL)
 - Exploits multiple channel at once (multilinear structure).
 - Embodiment.
- For more and more deaf, SL is equivalent to L1, while VL is experienced as a L2

THAT DEAF GUY



+ Vocal Language and Sign Language

A simple example



When presented with the words "vote" and "tea" in written form, deaf individuals sometimes confused the two (Klima & Bellugi, 1979). Although they do not sound or look similar when read out loud or written, they are formationally similar when signed in ASL. This is evidence for the conjecture that the deaf recode into signs when reading.

From <http://psych.nyu.edu/pelli/docs/azbel2004intel.pdf>

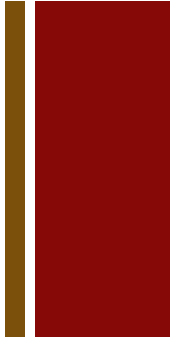
Deaf people may have no trouble communicating any idea in American Sign Language, or ASL, that can be expressed in English. But studies of ASL signers show that, on average, deaf high school seniors are likely to read at the level of a nine-year-old.

The explanation has always been that this is because they never learned to connect letters with sounds. But a recent study shows that deaf readers are just like other people learning to read in a second language.

Jill Morford

From <http://learningenglish.voanews.com/content/a-new-reason-for-why-the-deaf-may-have-trouble-reading-119728279/115194.html>

+ Vocal Language and Sign Language



Despite a vast part of deaf people experience difficulties with Vocal Language, deaf-oriented accessibility design is often carried out using Vocal Language.

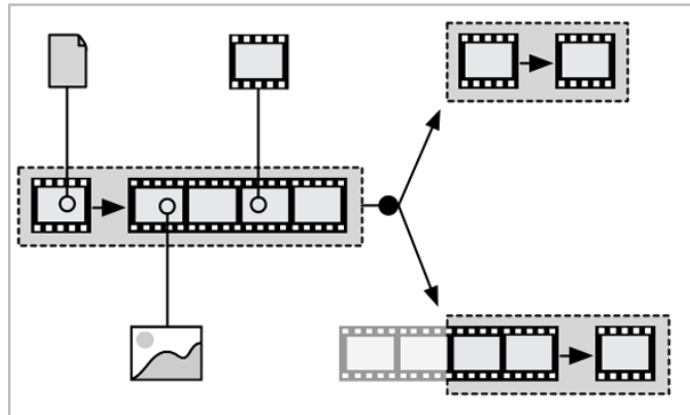
- Video captioning
- Transcription of audio content

+ Sign Language inclusion techniques

Videos

Deaf-oriented accessibility design using Sign Language is usually performed using videos.

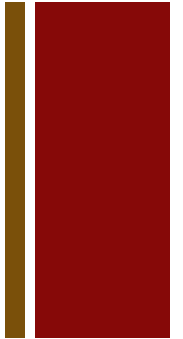
- Hypervideo technology
 - Sign Language Scent
 - SignLinking



Different features of Hypervideo technology.

+ Sign Language inclusion techniques

Videos

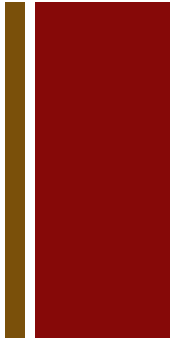


Videos cannot replace written text:

- Sequential access to information
- Search is not supported
- Annotation and tagging are cumbersome

+ Sign Language inclusion techniques

Written Sign Language



Why writing Sign Language is not yet feasible?

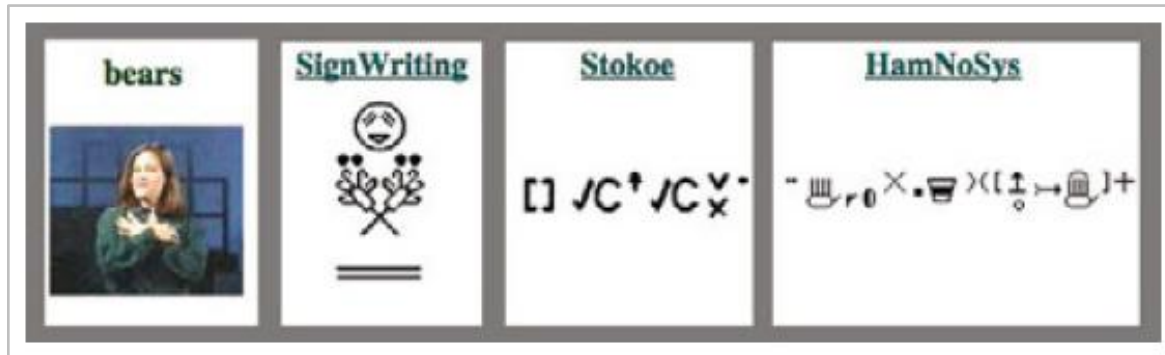
- Cannot be represented adapting any pre-existing notation.
- No widespread writing system.
- Different writing systems
 - Stokoe (1960s)
 - HamNoSys (1980s)
 - SignWriting (1970s)

+ Sign Language inclusion techniques

Written SignLanguage

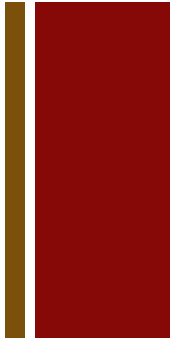


Visual comparison between SignWriting, Stokoe and HamNoSys.

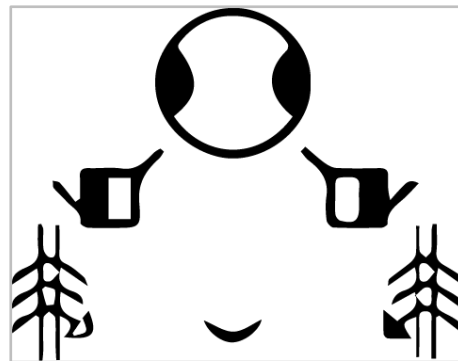


ASL sign for “Bear”, comparison between three different writing systems.

+ SignWriting

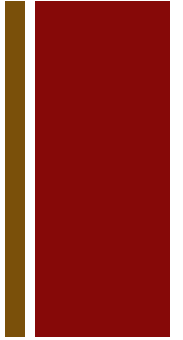


- A number of glyphs are arranged together to compose a sign
- Glyph represent the hand shapes, movements, and facial expressions of SLs
- About 40.000 glyphs!



LIS sign for “Fun”, written in SW.

+ SignWriting



Features of SignWriting:

- High iconicity
- Preserves the actual composition of the sign

From handwriting to digital writing:

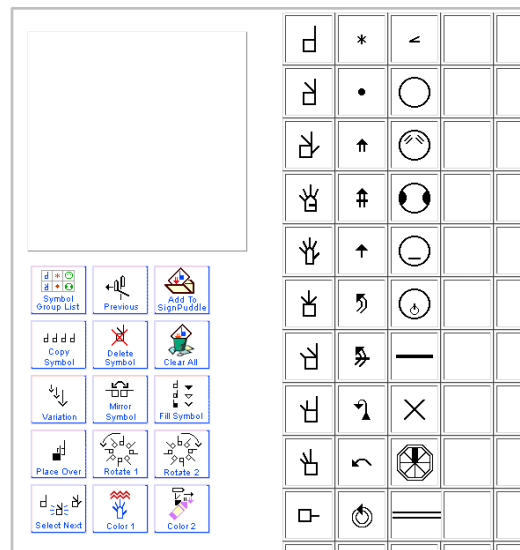
- Each glyph is identified by a code
- International SignWriting Alphabet

+ SignWriting

Supporting accessibility with SignWriting

■ Digital editors

- Pick a glyph and insert it on the sign composition area
- Manage the glyphs on the sign composition area
- Save the sign in different formats



Home screen of “SignMaker” digital editor.

+ SignWriting

Supporting accessibility with SignWriting

■ Web sites



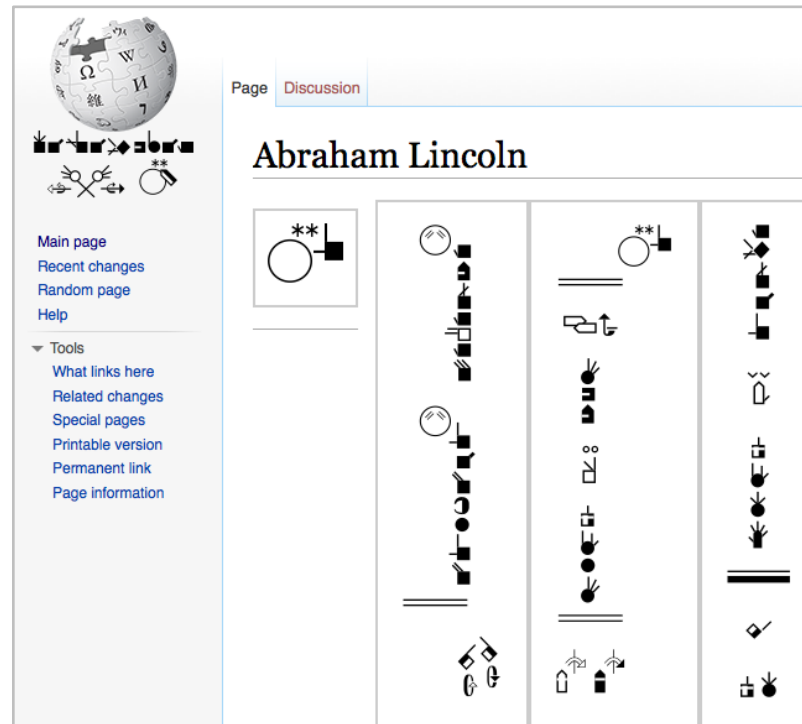
Home screen of “The SignWriting Website”.

+ SignWriting

Supporting accessibility with SignWriting



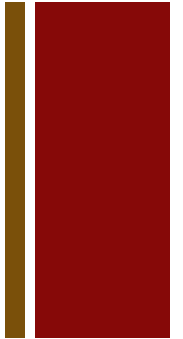
■ Wikipedia projects



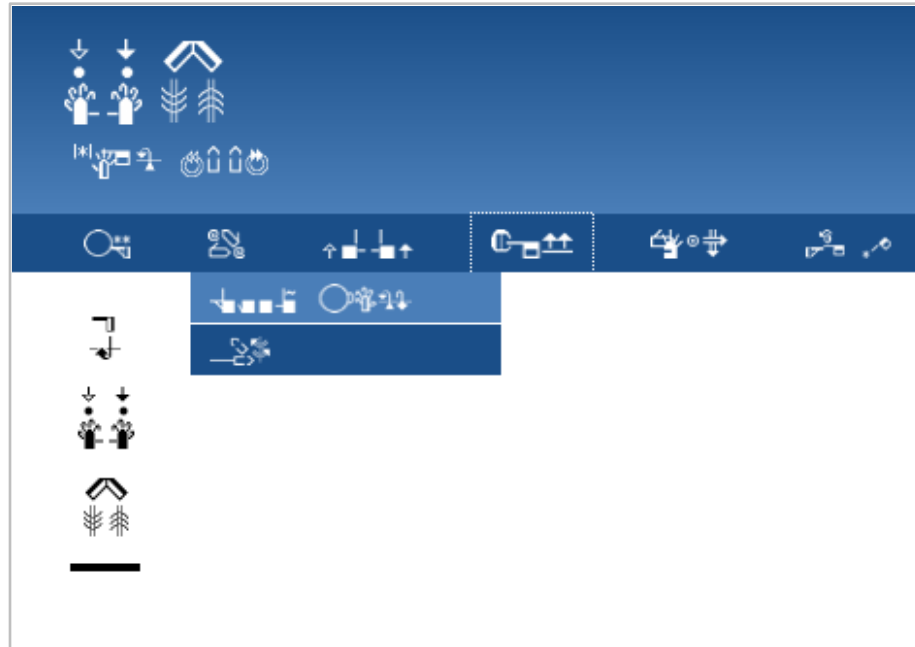
ASL Wikipedia page about "Abraham Lincoln".

+ SignWriting

Supporting accessibility with SignWriting



■ Blogs

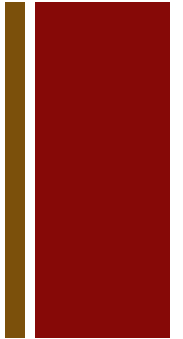


Home screen of “The Frost Village”, a bilingual (ENG-ASL) blog by Adam Frost.



Improving e-learning experience for deaf people

Integration example: SSwift

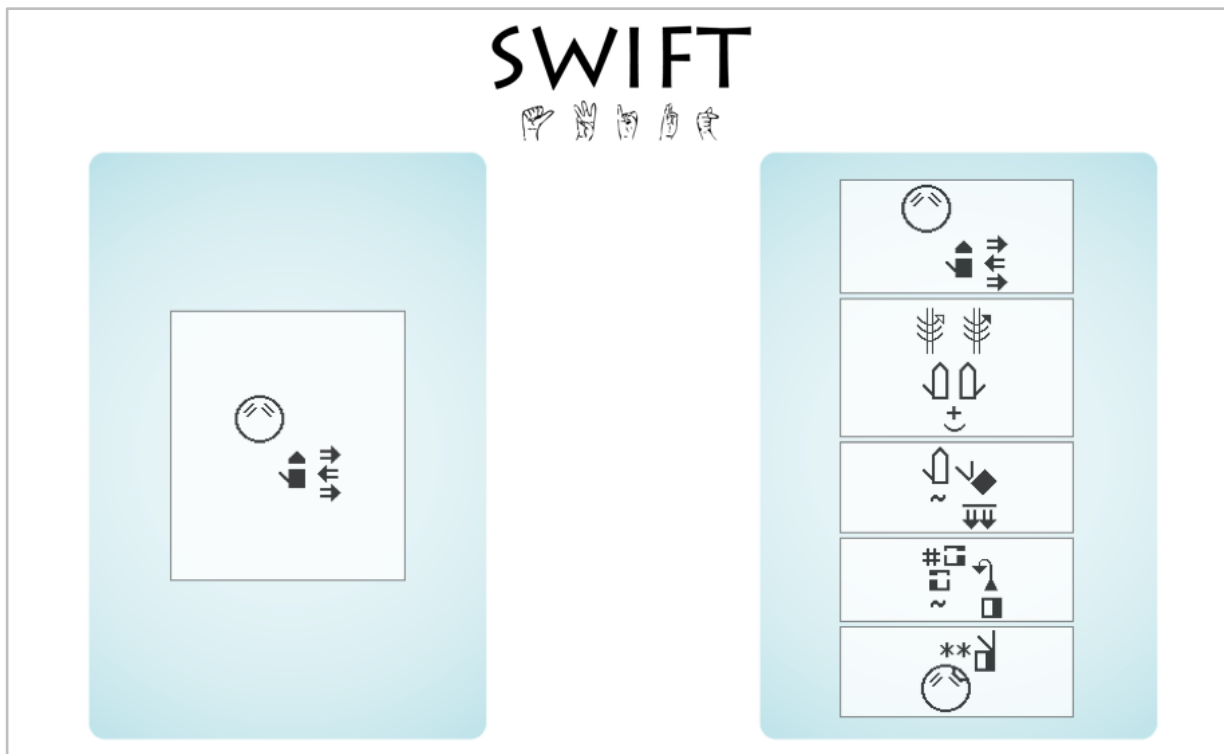


- Our SignWriting digital editor
 - Designed and developed in collaboration with the research team at ISTC-CNR (which includes many deaf people).
 - Application usability tested with deaf participants
 - New features with respect to the competitors
 - Sign composition assistance
 - New concept of glyph search engine
 - Signed stories

+ Improving e-learning experience for deaf people

Integration example: SWift

■ Our SignWriting digital editor

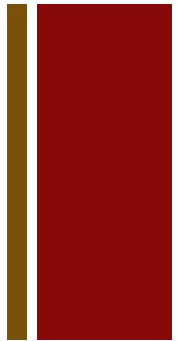


Home screen of "SWift" digital editor.

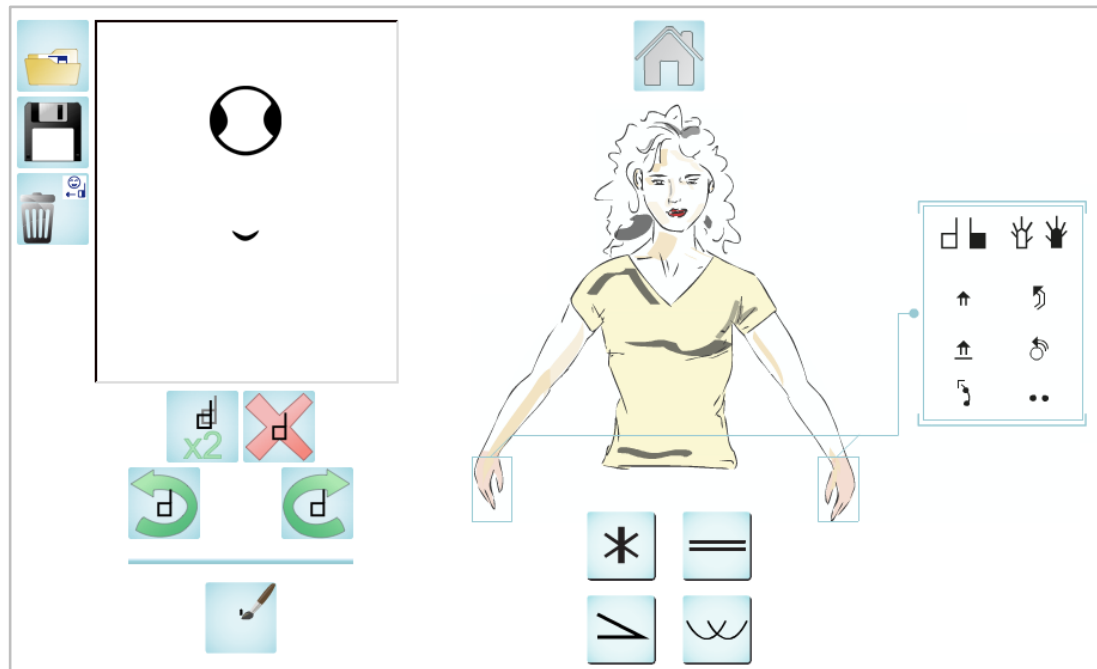


Improving e-learning experience for deaf people

Integration example: SWift



■ Our SignWriting digital editor

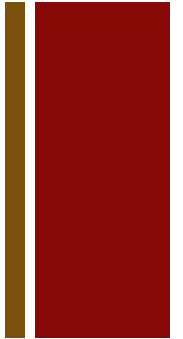


Sign composition interface of “SWift” digital editor.



Improving e-learning experience for deaf people

Integration example: SSwift

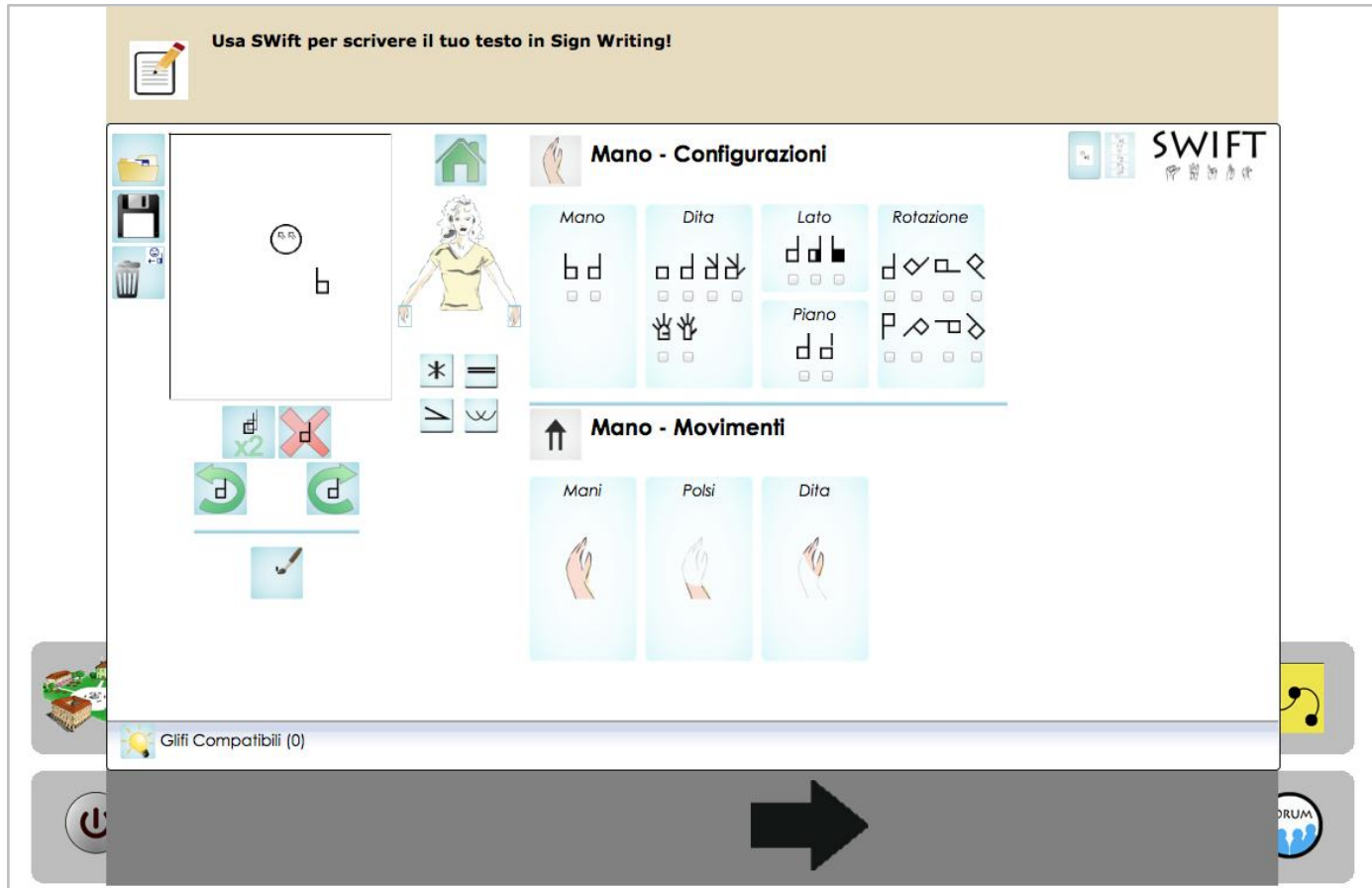


■ Integration features:

- Developed as a self-containing web application, it can be easily included within any web-based learning platform
- Already successfully integrated within a deaf-centered e-learning environment (DELE).
- Provides language support for:
 - Authoring tools for teachers
 - Communication tools for learners (chat, forums, etc.)

+ Improving e-learning experience for deaf people

Integration example: SWift

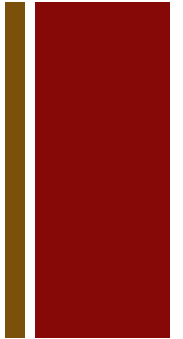


DELE interface, featuring SignLanguage support via SWift.



Improving e-learning experience for deaf people

SignWriting Optical Glyph Recognition (SW-OGR)

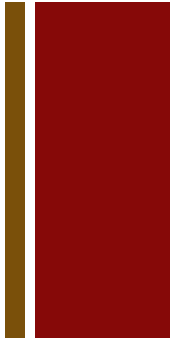


- The simplicity/speed/comfort of the handwriting is still unchallenged by modern SignWriting digital editors
- The traditional WIMP interface is still used both for accessing the application features and for the sign production process.



Improving e-learning experience for deaf people

SignWriting Optical Glyph Recognition (SW-OGR)



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



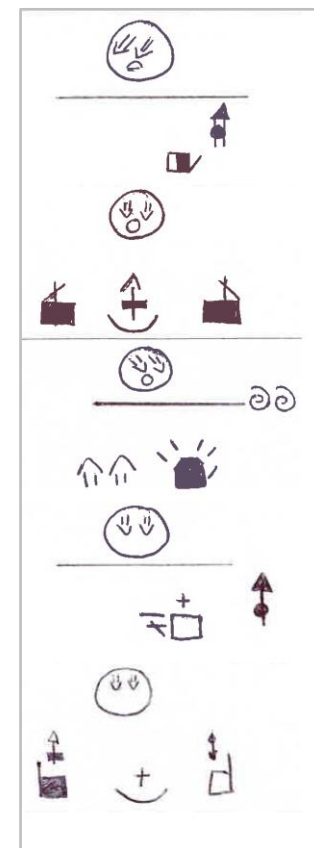
+ Improving e-learning experience for deaf people

SignWriting Optical Glyph Recognition (SW-OGR)



SignWriting Optical Glyph Recognition (SW-OGR)

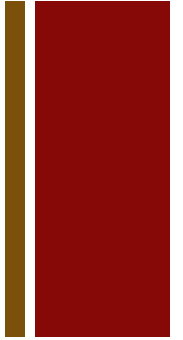
An application module designed to operate the electronic conversion (recognition) of user-produced images containing handwritten (or printed) SignWriting symbols into machine-encoded (ISWA) SW text.





Improving e-learning experience for deaf people

SignWriting Optical Glyph Recognition (SW-OGR)

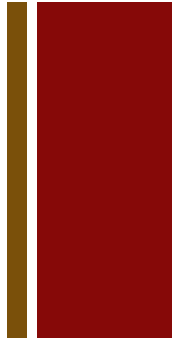


- No OCR-like pattern recognition techniques viable:
 - About 40.000 glyph – huge training required
 - No rigid rules for composition
 - Complex sign segmentation

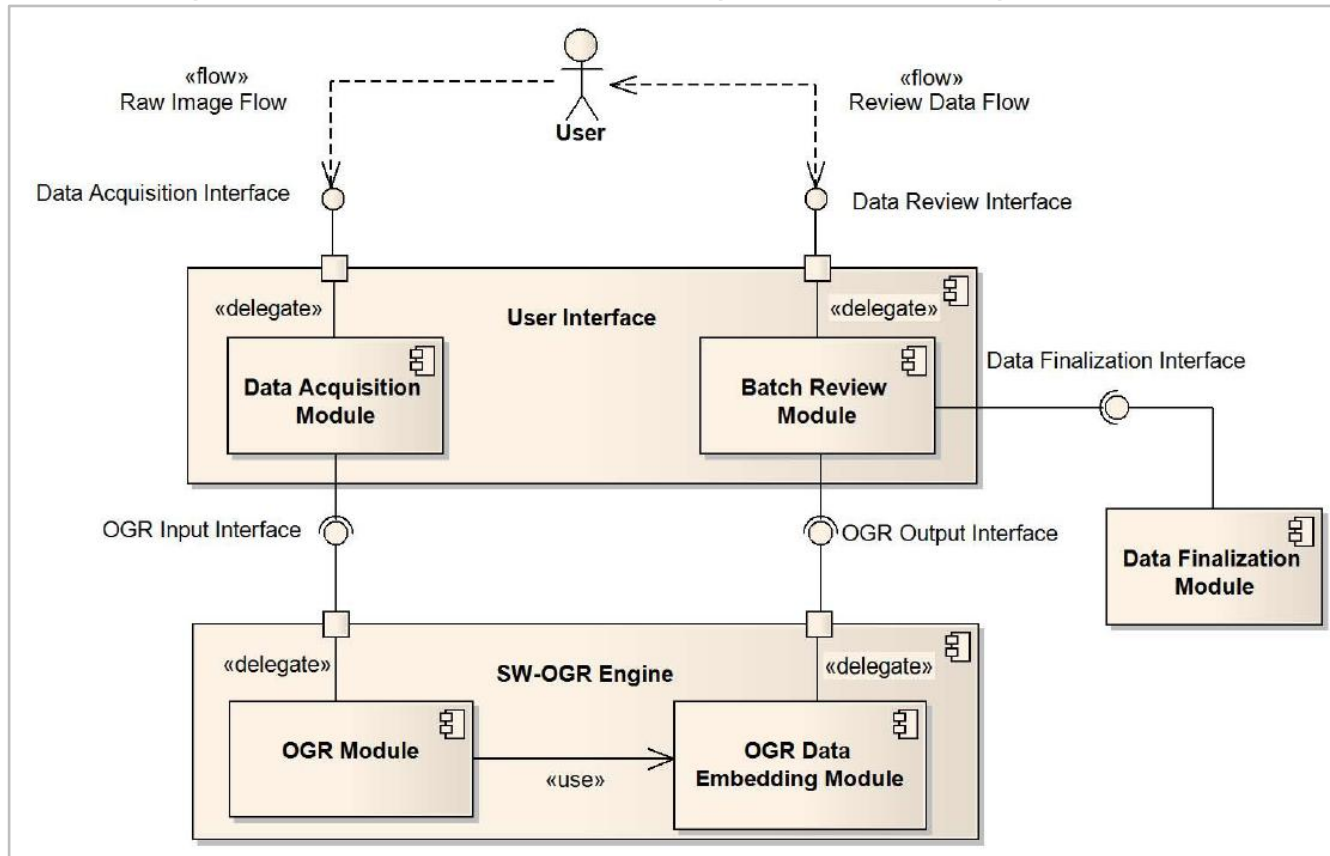


Improving e-learning experience for deaf people

SignWriting Optical Glyph Recognition (SW-OGR)



■ SignWriting Optical Glyph Recognition integration:





Improving e-learning experience for deaf people

SignWriting Optical Glyph Recognition (SW-OGR)

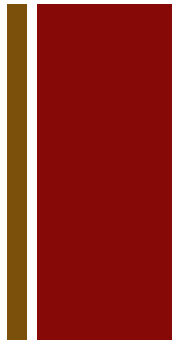
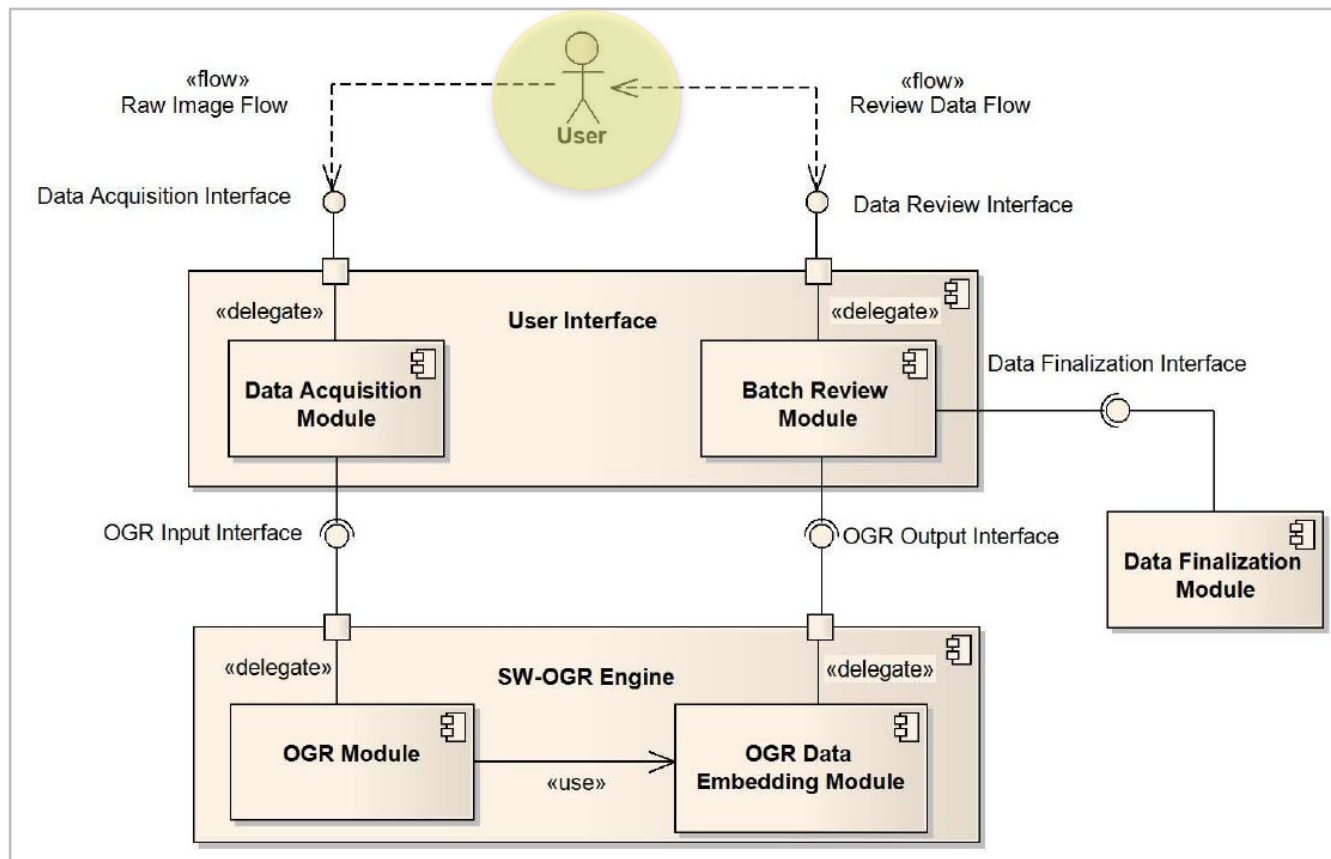


Image (handwritten SignWriting text) production by the user





Improving e-learning experience for deaf people

SignWriting Optical Glyph Recognition (SW-OGR)

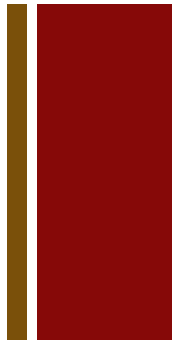
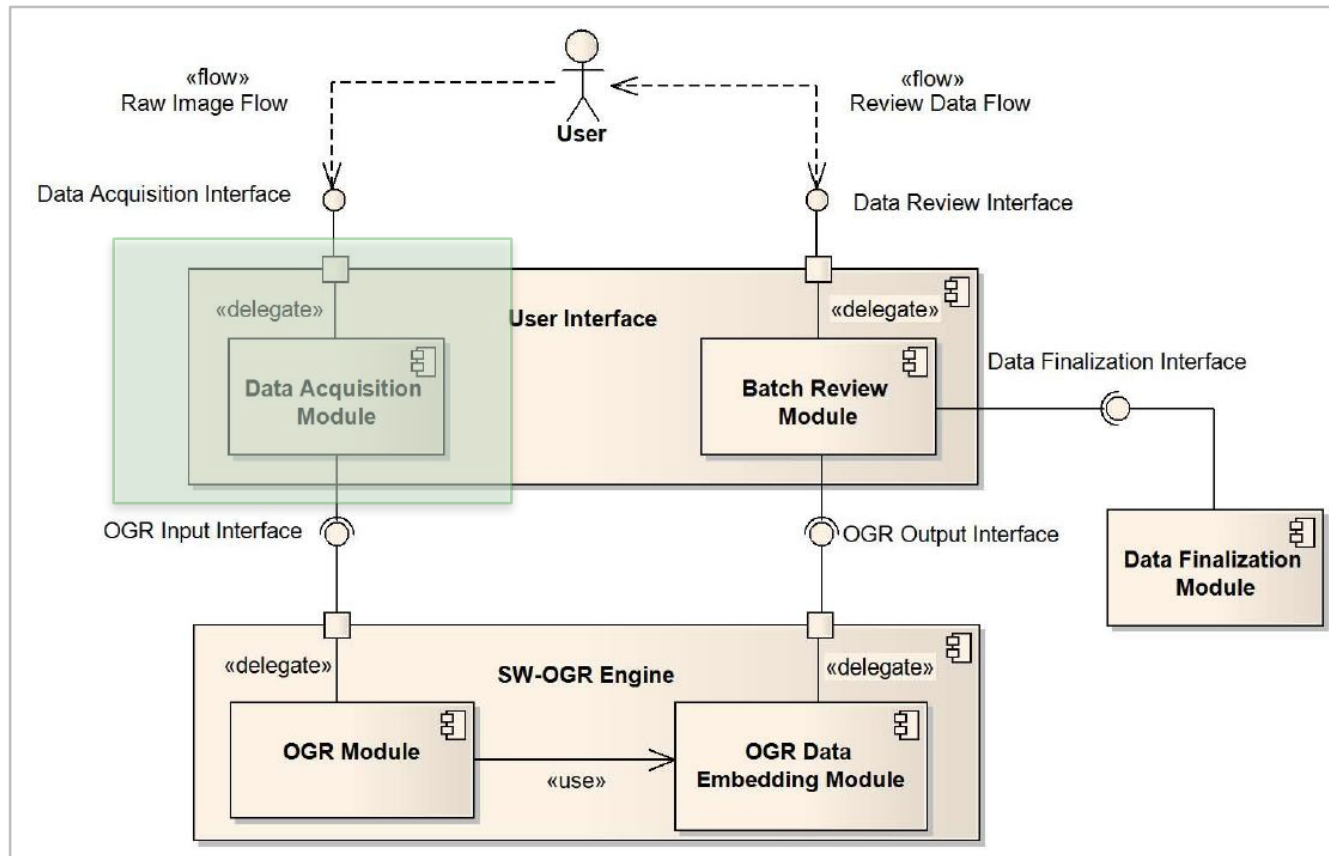


Image acquisition interface



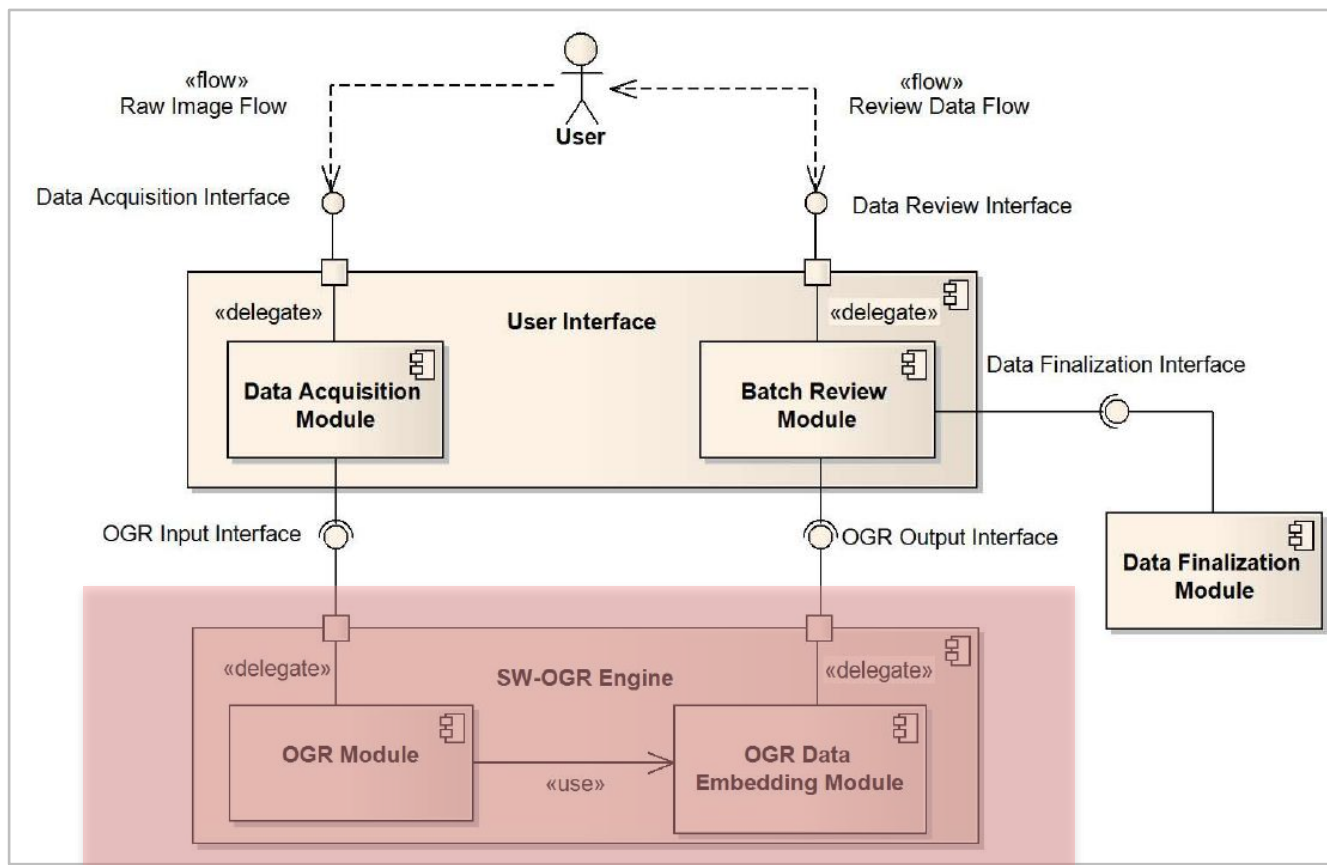


Improving e-learning experience for deaf people

SignWriting Optical Glyph Recognition (SW-OGR)



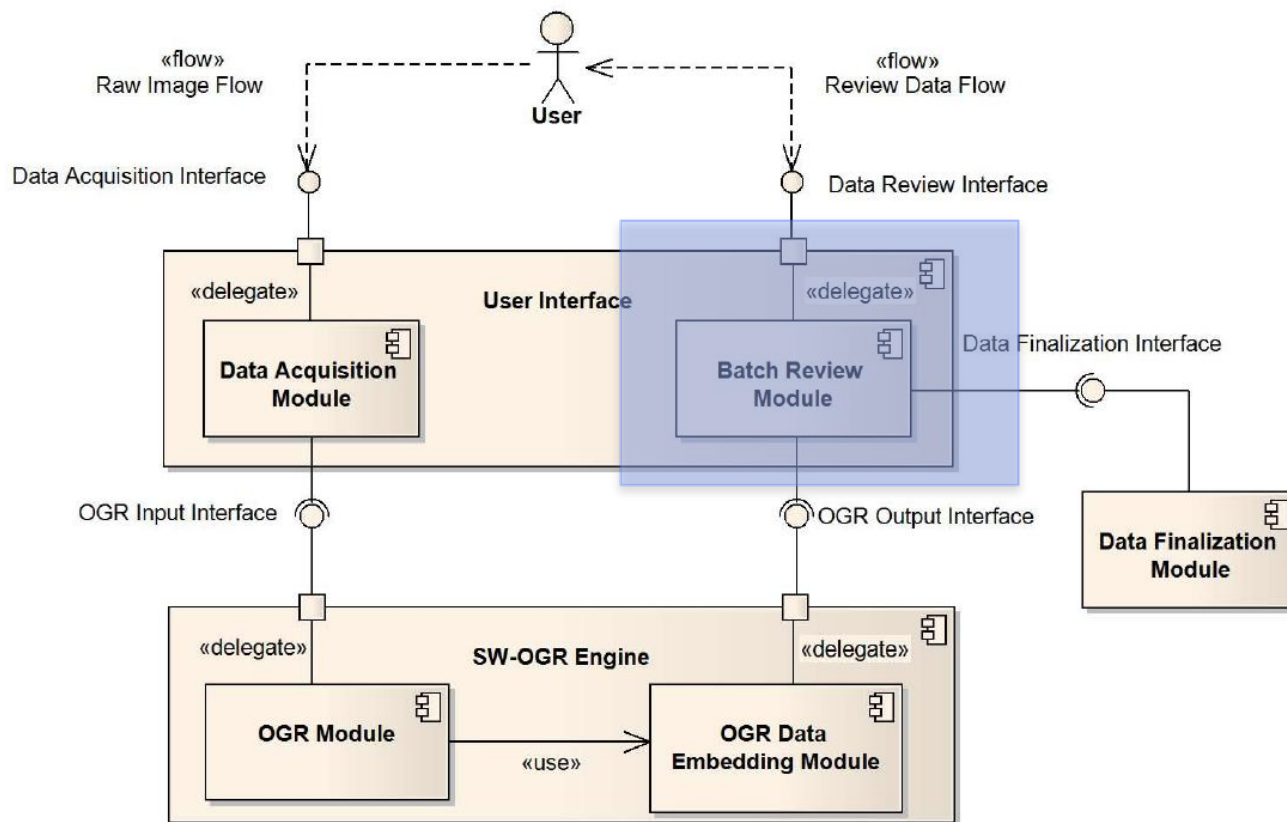
Optical Glyph Recognition by SW-OGR



+ Improving e-learning experience for deaf people

SignWriting Optical Glyph Recognition (SW-OGR)

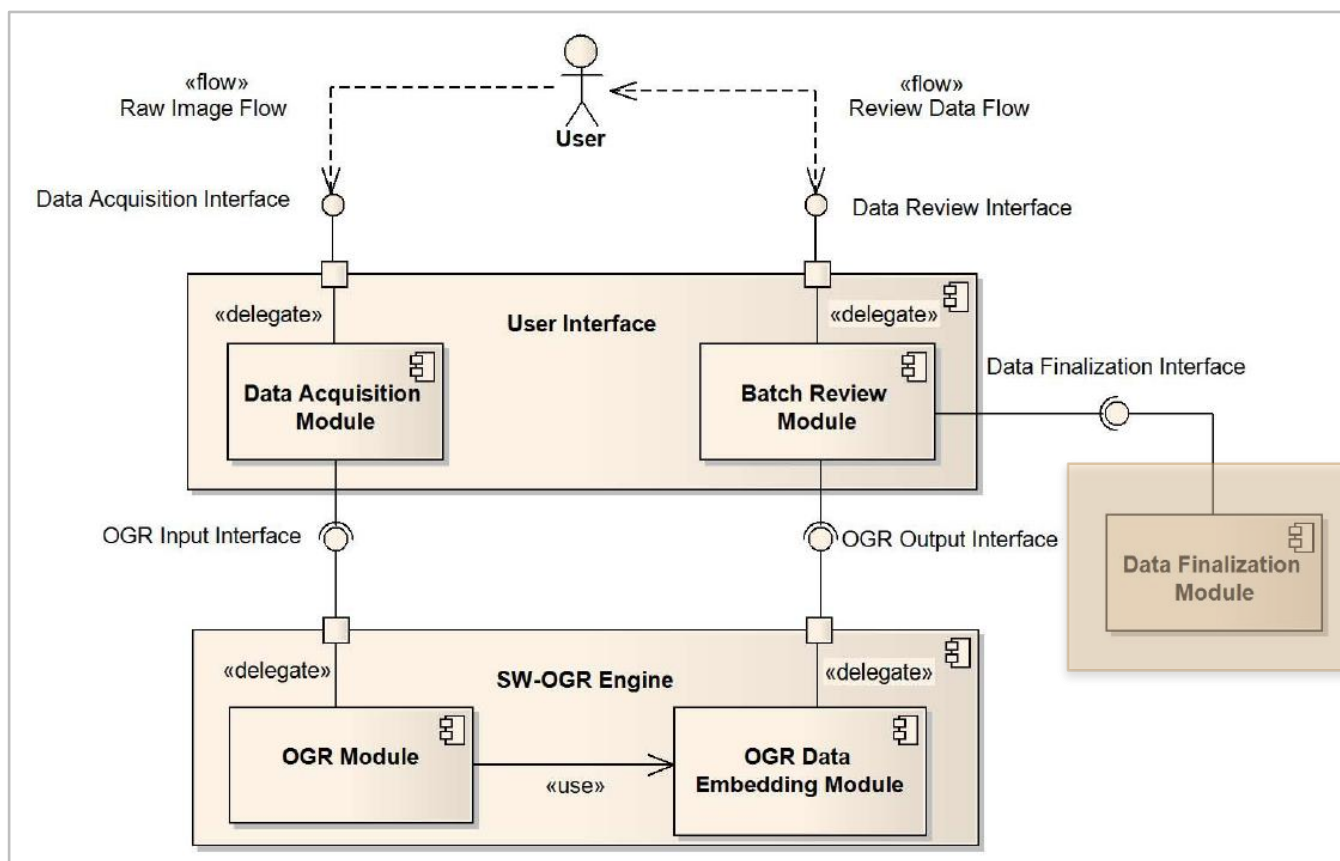
Human-assisted output review module



+ Improving e-learning experience for deaf people

SignWriting Optical Glyph Recognition (SW-OGR)

Data finalization module



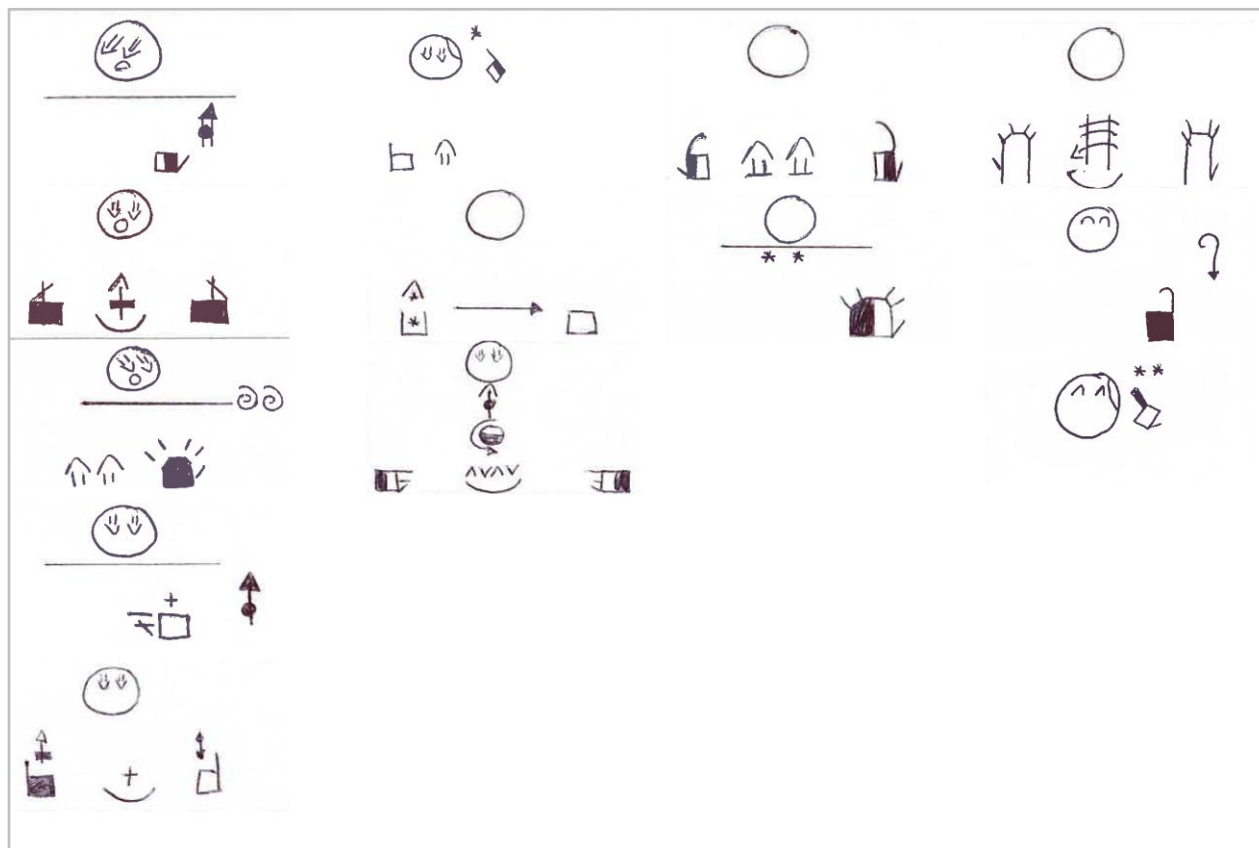


Improving e-learning experience for deaf people

SignWriting Optical Glyph Recognition (SW-OGR)



OGR in action – Data acquisition (and pre-processing)



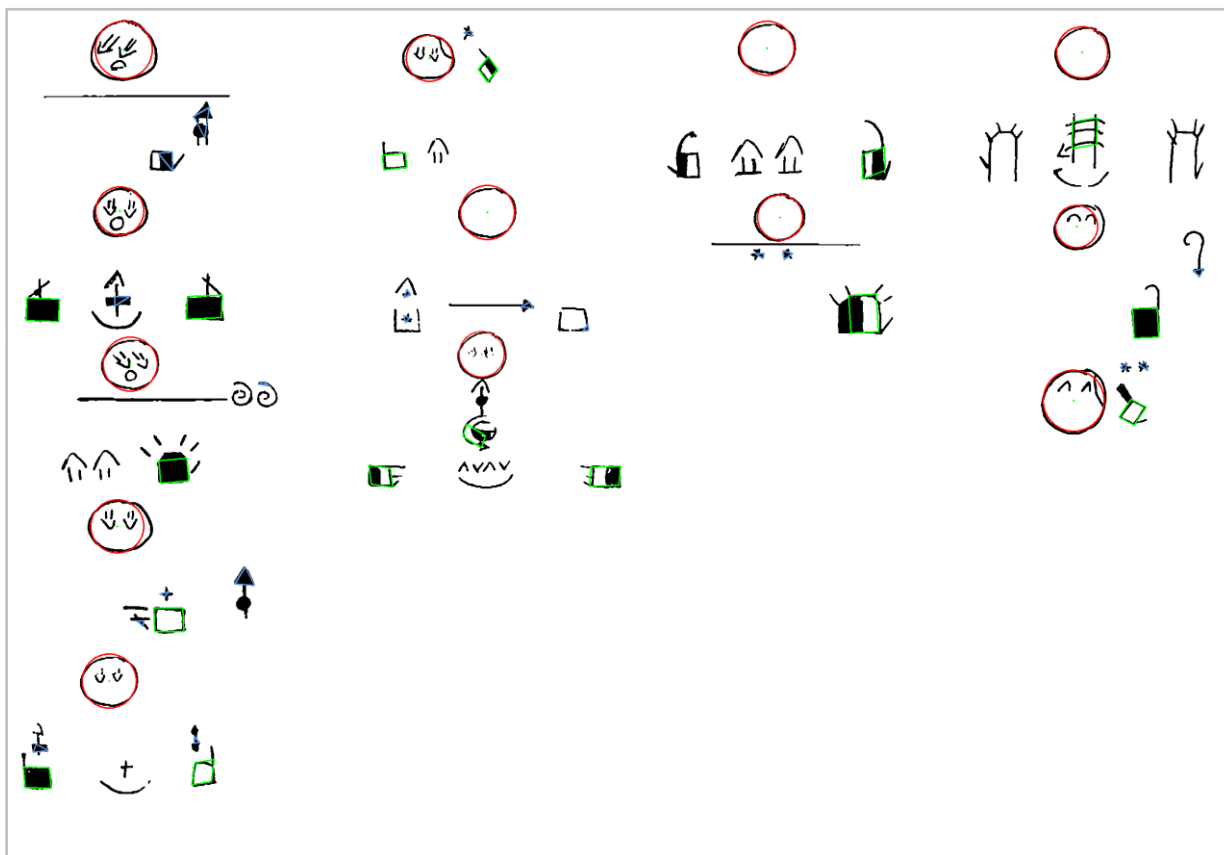


Improving e-learning experience for deaf people

SignWriting Optical Glyph Recognition (SW-OGR)



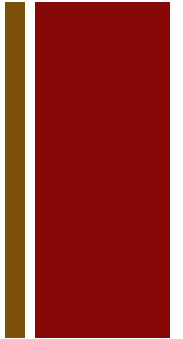
OGR in action – Geometric shape detection



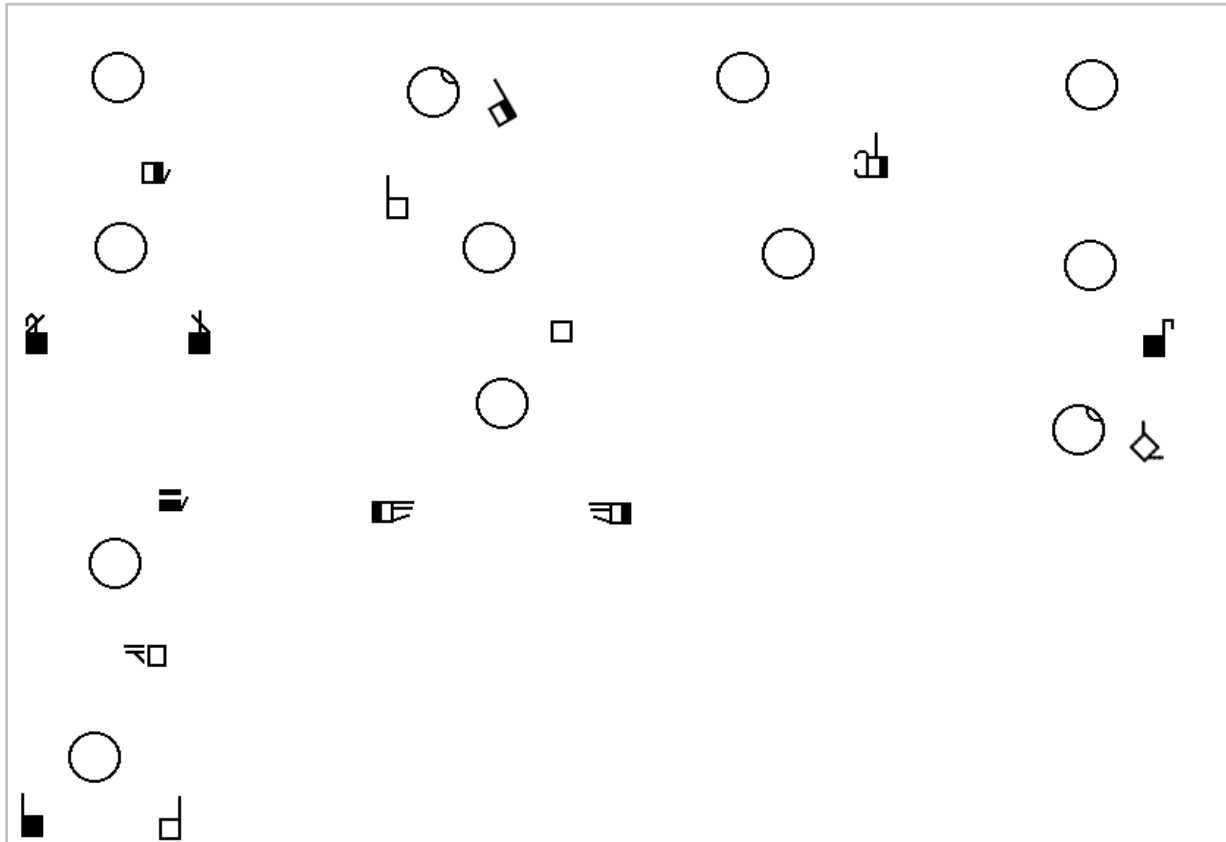


Improving e-learning experience for deaf people

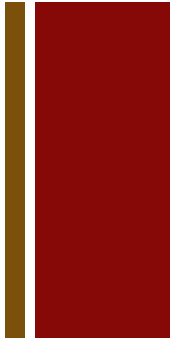
SignWriting Optical Glyph Recognition (SW-OGR)



OGR in action – Recognition output (in development)



+ Conclusion and Future



- The inclusion of deaf people requires to carefully rethink the formulation and design of appropriate frameworks for ICT deployment
- Interactive tasks and search may take great advantage from exploiting a written SL expressions
- The SWORD (SignWriting Oriented Resources for the Deaf) project will represent a step towards full integration of deaf people in digital society

Towards improving the e-learning experience for deaf students

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Just like any other software, e-learning applications need to be understood by their users in order to be effectively exploited. This particular class of software requires an even more careful design, during which many issues must be addressed.

In most cases, attention merely focuses on features available on the container, i.e. the software platform to deploy the e-learning content [1]. However, content, i.e. learning material, is even more important when addressing users with special needs [2][6]. This calls for devising ways to transmit the information through the best suited (sensorial) channels for each category of users. Besides usability, accessibility becomes a main requirement.

Deaf people are heavily affected by the digital divide. Most accessibility guidelines addressing their needs just deal with captioning and audio-content transcription. Only a few organizations, like W3C [11], produced guidelines dealing with a most distinctive feature of deaf people: Sign Language (SL). SL is, in fact, the visual-gestural language used by many deaf people to communicate among themselves.

The present work aims toward e-learning accessibility for deaf people. In particular, we propose preliminary solutions to tailor activities which can be more fruitful when performed in one's own "native" language.

A condition to achieve this goal for deaf learners is integrating SL resources and tools within e-learning applications, since the benefits of this methodology cannot be matched by any other accessibility solution [7].

Videos are a powerful resource in deaf-oriented accessibility; nonetheless, written language cannot be completely replaced by video resources. Some functions cannot be effectively exploited with the support of video resources; they range from general ones, such as searching and browsing, to more content-specific, like annotation and tagging.

The communication channel employed and the simultaneity of the spatial-temporal patterns by which information is transmitted make impossible to represent SL using the same systems developed for spoken languages. Many writing systems have been devised for SL (see [5] for a comparison), but none has been widely accepted by the deaf communities. We focused on SignWriting (SW), a writing system using visual symbols to represent the handshapes, movements, and facial expressions of any SL [10] (see Fig. 01 for an example).

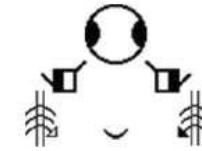


Figure 01: LIS sign for "FUN", written in SW.

SW has been already successfully exploited to build whole deaf-oriented websites, such as the ASL Wikipedia Project [9], which employs deaf ASL signers to produce ASL Wikipedia articles.

While SW can be simply written with pencil and paper, to ensure its diffusion various digital editors have been developed. Those editors basically give the possibility to write signs and save them in different formats; our proposal is to introduce SL integration on e-learning platforms through the use of SW editors.

Our team has devised SWift, a web-based SW editor [3], whose features have been conceived together with its main target users, deaf people, to ensure a high degree of usability and accessibility [2]. Since many e-learning environments are implemented as web-based applications, they can easily embed SWift for achieving a prompt SL support for e-learning, to grant didactic experts the design of Learning Objects (LOs) written in SL, and to allow deaf students the possibility to learn using their own language. A first step towards integration of SW within didactic content authoring/fruition interfaces has been the integration of SWift inside DELE, a platform designed taking into consideration the essentially visual learning style of deaf people [4].

Despite the efforts, SW editors are still far from providing a composition interface able to match the simplicity of handwriting. Currently, all SW editors rely heavily on WIMP interfaces, both for accessing the application features and for the SW production process. This can make composing a SW text rather laborious.

We evaluated the possibility to design a new generation of SW editing applications, for partially overcome the constraints of WIMP interfaces. The new tools are intended to relieve the user of any burden related to clicking, dragging, browsing during the SW production process, and to provide an interaction style as similar as possible to natural handwriting. We are trying to achieve this goal by producing a SignWriting Optical Glyph Recognition (SW-OGR) engine, which convert real-time produced (or batch-fed) images containing handwritten SW symbols into machine-encoded SW text.

In the present work we introduce the architectural design for the new generation of SW editors featuring a SW-OGR engine. Our aim is to support both creation and fruition of SW LOs by making them more natural and fast to handle in digital settings. We hope in this way to offer more and more deaf people the chance to access distance learning. Furthermore, once the SW-OGR will be fully working, it will also be possible to exploit it in touch-screen-based interaction, and in "transcribing" the content of signed videos, thus providing a complete set of tools to support SL.

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