Loracrafft – A client-server architecture to translate hieroglyphic texts word by word with a smartphone

Didier DTL Morandi
January 21, 2025

Abstract

Solutions combining CNN and attention mechanisms within Deep Learning have now reached maturity for the recognition and classification of Egyptian hieroglyphs, idem for computer-aided translation algorithms. But word-by-word translation requires a corpus that current smartphones will not be able to host given its presumed and desired size. This is why we propose, in the Loracrafft project, a client-server architecture that will allow the process of reading, recognition and transliteration of texts to run on a smartphone (the client) and the translation and management of reference texts on a remote server on the Web, communicating synchronously with the client via a WebSocket-TCP protocol.

1. Introduction

Year 2022 was a year of a double celebration: The "understanding" of hieroglyphic writing by Jean-François Champollion in 1822 and the fabulous discovery of Tutankhamun's tomb by Howard Carter exactly one hundred years later. It is sufficient reading the *Egyptian Grammar* conceived by Champollion (Champollion 1836) and published by his brother Jacques-Joseph Champollion-Figeac posthumously to understand why the translation of Middle Kingdom hieroglyphic texts is so complicated and certainly not within the reach of Tourists who come to visit the remarkable sites of Egypt.

The arrival of personal computers in the 80s and object-oriented languages, such as Python in 1991, combined with new programming techniques that have shown their usefulness for pattern recognition and automated translation - such as Convolutional Neural Networks and Attention Mechanisms within Deep Learning - has allowed the development of computer projects aiming at translating hieroglyphs. Let us mention for the record the precursor *Tomb Reader* by Morris Franken and Jan van Gemert (Franken 2015), *Fabricius* by the Google/Ubisoft tandem (Google 2017), *Hieroglyphs AI* by Evgeniy & Alexander Sulimov (Sulimov 2020), *Pixoglyphe* by Fleur Brun *et al*. (Brun 2020), *DeepScribe* by Krishnan *et al*. (Krishnan 2020), *GlyphNet* by Andrea Barucci *et al*. (Barucci 2022) and *Loracrafft*[1] by the author (Morandi 2022).

Unlike the previous ones, the *Loracrafft* project intends to translate texts word by word and not hieroglyphic sign after sign. But the need to make a corpus available to the embedded software , corpus which should essentially be composed of dictionaries such as those of Erman (1926), Faulkner (1962), Hannig (2003, 2006) and *VégA*[2] (2015), plus a large number of reference texts containing transliterations and translations (initially in English, then in French and German) like the ones from the *Thesaurus Linguae Aegyptiae*[3] and *Projet Ramses*[4] requires the choice of storing all this data on a remote server with large storage capacities, hence the need to set up a client-server architecture, an architecture which we present below.

[1] https://www.shpylgoreih.fr/loracrafft_en.htm
[2] https://vega-vocabulaire-egyptien-ancien.fr/
[3] https://thesaurus-linguae-aegyptiae.de/home?lang=en
[4] http://www.egypto.ulg.ac.be/Ramses.htm

2. Architecture

S34 G5 S29 N16 N16 G14 I12 Z1 S29 N16 N16 M23 L2 Z1

anx-G5 zmA:tA:tA nbty-zmA:tA:tA-sw:t bit:t

"Life, prosperity, health to the king who unites the two lands,
under the protection of the two Ladies,
he who unites the two lands and the reeds,
the king of upper and lower Egypt."

archi_1_En.jpg

The image on the previous page shows:

1. the inscription to be translated

2. the use of a smartphone to capture a group of signs (the user will start the application, take a photo and manually trigger local processing[5])

3. identification of signs and classification into Gardiner codes

4. split to words and transliteration

5. automatic transfer of the transliterated characters string to the server via a synchronous WebSocket connection[6]

6. reception by the smartphone of the text translated word by word

7. audio reading of the translation displayed on the screen in the language chosen when setting up the application

a) Detailed description of the architecture

The project requires a smartphone (or tablet) with the *Loracrafft* application installed on it, so it is planned to develop two versions of the application: one for iOS and one for Android.

Ideally, no minimum size for the capacity of the equipment should be imposed in order to avoid forcing the user to make an expensive purchase[7].

The Loracrafft application will be locally in charge of:

- taking photos
- recognizing signs
- classifying them into Gardiner codes
- splitting to words and transliterating them
- sending the result to the server for translation
- receiving the translation
- broadcasting the translation to the user (text and sound)

The server, which will contain the database and the translation software, will be made available to users free of charge from the *Loracrafft* website[8].

The WebSocket-TCP synchronous connection will be initialized when the application is launched and maintained permanently, with an automatic restoration process in the

[5] On-the-fly translation by sweep-and-scan will not be provided in version 1 of the software.
[6] We believe that an HTTPS-type connection, which is asynchronous by definition, will significantly slow down the communication between the server and the client, and will not allow the server to transmit data to the client until the client requests it.
[7] For the record, at the date of publication of this document, an iPhone 16 Pro with a maximum capacity of 1 TB (1024 Gigabytes) costs around 1,200 euros (in France).
[8] There are no plans to produce an application that would be commercialized. The present work is a research study, sources and resources will be posted on GitHub.

event of a power outage as long as the application is active (loss of the GSM network for example).

b) Evolution

A development currently being studied would consist of the server searching in its corpus for occurrences of, for example, the first four translated words, a setting that should be configured to a minimum of four words or more.

As a matter of facts, an exercise carried out with the Google Search Engine gave the following results:

searched string[9]	**number of words**	**number of occurrences**
« search »	1	25 270 000 000
« search for »	2	2 560 000 000
« search for three »	3	55 000 000
« search for four words »	4	26 600
« search for five different words »	5	1

Then, the server would query its database to search for the texts it may know that contain these words translated together, and this could give the following result:

Transliteration received	Translation
Wsjr jṯ n=k msḏḏw Wnjs nb.w	Osiris, seize anyone who hates Unas

Search result in the corpus (partial)

Wsjr jṯ n=k msḏḏw Wnjs nb.w	Osiris, seize anyone who hates Unas
mdw m rn=f ḏw	and the one who dishonors his name!
Ḏḥwtj j.sb jṯ sw n Wsjr	Thoth, go, seize the one who threatens Osiris,
jn mdw m rn n(j) Wnjs ḏw	carry away the one who dishonors the name of Unas,
d n=k sw m ḏr.t=k	and put him in your hand!

Then, the server would send back to the smartphone something like:

"*I have identified that the six words that I just translated are part of a text I know, engraved on the north wall of the passage between the burial chamber and the antechamber*[10] *of the pyramid of Unas in Saqqara, and also on the first register of the north wall of the burial chamber*[11]*. Do you want me to read you an excerpt?*" (etc.)

[9] The double quotes are mandatory to ensure that the text searched is a group of contiguous words.
[10] Spruch 23, § 16a [W/F-A/N 7] & 16b [W/F-A/N 9].
[11] [W/F/Ne I 1-4].

3. A notable advance since 2022

On March 16, 2023, Asmaa Sobhy, Mahmoud Helmy, Michael Khalil, Sarah Elmasry, Youtham Boules and Nermin Negied, from the *Digital Egypt Builders Initiative*[12], published a paper entitled " An AI Based Automatic Translator for Ancient Hieroglyphic Language - From Scanned Images to English Text" (Sohby 2023), in which they write in the introduction: "*In this work, the aim is to decipher this remarkably interesting language to make it easier for tourists to understand the ancient Egyptians' scripts, through the automatic detection and recognition of hieroglyphs then and translating them into English*."

But this study has – apparently – not led to any implementation.

On January 12, 2025, the author published a first paper (Morandi 2025) on the *Loracrafft* project on Academia.edu, we hope that the present publication will continue to motivate researchers on the subject.

4. Conclusion

We noticed that the automated translation of Middle Kingdom egyptian hieroglyphic texts has reached maturity, time is now to gather a team of developers to put it into practice.

Egyptologists and Computer Scientists, the *Loracrafft Project* speaks to you? Let's talk about it together[13].

Special thanks to Alexander Sulimov, Amandine Marshall, Andrea Barucci, Arnold McDonald, Bernard Mathieu, Jan van Gemert, Jean Winand, Jean-Yves Empereur, Maryline Sellier, Morris Franken, Nagai Masakatsu, Raymond Monfort, Renaud de Spens, Sébastien Biston-Moulin and Serge Rosmorduc for their support, advices and encouragements.

5. References

Brun 2020. *Pixoglyphe* – Detection and recognition of hieroglyphs. [online, French]
https://www.shpylgoreih.fr/documents/Brun_Rapport_Pixoglyphe_projet_VEGA_2020.pdf

Champollion 1836. *Egyptian Grammar*, Firmin Didot, Paris. [online, French]
https://www.shpylgoreih.fr/documents/Champollion_Grammaire_egyptienne_1836.pdf

Erman 1926. *Wörterbuch der Aegyptischen Sprache*, Academie-Verlag, Berlin. [online]
https://www.shpylgoreih.fr/documents/Erman_Worterbuch_der_Aegyptischen_Sprache_1926.pdf

Faulkner 1962. *Concise Dictionary of Middle Egyptian*, Griffith Inst. Oxford. [online]
https://www.shpylgoreih.fr/documents/Faulkner_Concise_Dictionary_of_Middle_Egyptian_1962.pdf

Franken 2015. *Tomb Reader* – Creating an App that lets you read hieroglyphs. [online]
https://tombreaderapp.com

[12] https://debi.gov.eg/
[13] didier.morandi@gmail.com - https://www.shpylgoreih.fr/

Google 2017. *Fabricius* – Decoding Egyptian hieroglyphs with Machine Learning. [online, French] https://artsandculture.google.com/experiment/fabricius/gwHX41Sm0N7-Dw

Hannig 2003. *Ägyptisches Wörterbuch*, volume 1, Verlag, Mainz-am-Rhein. [online] https://www.shpylgoreih.fr/documents/Hannig_Aegyptisches_Worterbuch_I_2003.pdf

Hannig 2006. *Ägyptisches Wörterbuch*, volume 2, Verlag, Mainz-am-Rhein. [online] https://www.shpylgoreih.fr/documents/Hannig_Aegyptysches_Worterbuch_II_2006.pdf

Krishnan 2020. *DeepScribe* - Localization and classification of Elamite cuneiform signs via Deep Learning. [online] https://voices.uchicago.edu/ochre/project/deepscribe

Morandi 2022. *Loracrafft* - Computer-Aided reading, classification, transliteration and translation of hieroglyphic texts. [online] https://www.shpylgoreih.fr/loracrafft_en.htm

Morandi 2025. *Computer-Aided Hieroglyphs Translation: CNNs Deserve Your Deep Attention* [online] https://www.shpylgoreih.fr/documents/Morandi_Computer_Aided_Hieroglyphs_Translation_CNN_deserve_your_Deep_Attention_2025.pdf

Molen 2000. *A Hieroglyphic Dictionary of Egyptian Coffin Texts*, Brill. [online] https://www.shpylgoreih.fr/documents/Molen_Hieroglyphic_Dictionary_of_Egyptian_Coffin_Texts_2000.pdf

Nederhof 2024. *Hieroglyphs OCR - Transcribe image of hieroglyphic text to Unicode*. [online] https://github.com/nederhof/hocr

Sohby 2023. *An AI-Based Automatic Translator for Ancient Hieroglyphic Language - From Scanned Images to English Text*. [online] https://www.shpylgoreih.fr/documents/Sobhy_An_AI_Based_Automatic_Translator_for_Ancient_Hieroglyphic_Language-From_Scanned_Images_to_English_Text_2023.pdf

Sulimov 2020. *Hieroglyphs AI*. Automatic identification of Gardiner codes. [online] https://www.hieroglyphs.ai