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Madrasati-Signs: A Hybrid Crowdsourcing Approach to Creating a Moroccan Sign Language School Dictionary for General and STEM Terms

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***Abstract*—In this paper, we present Madrasati-Signs, an innovative, web-based crowd-sourcing platform aimed at supporting Deaf education by documenting STEM (Science, Technology, Engineering, and Mathematics) and general school vocabulary in Moroccan Sign Language. Most crowdsourced datasets focus on widely used sign languages such as American Sign Language (ASL) and British Sign Language (BSL), while many understudied sign languages remain underrepresented. Expanding crowdsourcing initiatives to include lesser-known sign languages is crucial for linguistic inclusivity. The platform is designed to facilitate access to education for the Moroccan Deaf community, with a particular focus on STEM subjects. By leveraging the contributions of the Deaf community, Madrasati-Signs enhances language documentation using multiple input modes, allowing for regional variations and integrating avatar technology to animate signs. This initiative is expected to strengthen educational accessibility while also providing data for linguistic research. We address crowdsourced data quality and consistency through a hybrid approach that combines crowdsourcing with expert validation. For this purpose, we have established a local leadership structure paired with contacts at local Deaf associations in the twelve regions of Morocco.**

***Index Terms*—Crowdsourcing, Sign Language Documentation, Avatar Technology, Deaf Education**

I. Background and Motivation

Sign languages are visual-gestural communication systems that lack a standardized written form. In contrast, spoken languages rely on auditory processing and are typically recorded using alphabetic systems, where letters represent sounds in a specific sequence. This allows spoken languages to be easily captured and processed through speech or text. However, for individuals who rely on vision to develop language, communication is structured differently, following visual rather than auditory principles. Sign languages primarily use manual gestures and facial expressions, incorporating a range of techniques that visually and kinesthetically convey meaning.

Unlike spoken languages, there is no widely accepted written system for encoding sign languages. As a result, the representation of sign languages in requires visual media such as graphics, animation, or video. [1] introduced the concepts of *chereme* and *cherology* (from the Greek word "χείρ" meaning "hand"). He proposed that *cheremes* function as the basic units of signed communication, analogous to phonemes in spoken languages. Stokoe classified signs into four main components: *tab* (location, from the Latin *tabula*), *dez* (handshape, from *designator*), *sig* (movement, from *signation*), and, according to some researchers, *ori* (orientation). Additionally, head and body movements, facial expressions, and mouth movements phonemically contribute to the structure of sign language.

Several efforts have been made to create a written system for sign languages, such as SignWriting, but these systems remain largely unused or unrecognized by Deaf communities and service providers. The challenge of developing a widely adopted written representation continues to pose barriers to the integration of sign languages into text-based communication and digital platforms.

Moroccan Sign Language (MSL) is an under-documented and poorly resourced language. Currently, there is very little available research on MSL, with almost no comprehensive description of its structure and usage. Our work has the potential to expand knowledge and understanding of MSL, contributing not only to sign language research but also to broader linguistic studies, which have traditionally focused on spoken languages and widely recognized Western sign languages. By documenting MSL, our work may provide new insights into sign language typology and variation, both globally and within North Africa. Additionally, it offers an opportunity to refine and advance methodologies for sign language documentation.

Despite its significance, MSL remains largely understudied, and societal stigma surrounding Deafness and sign language use persists in Morocco. To address these challenges, our work actively involves community members in the documentation process, fostering greater recognition and inclusion of MSL. We have established a local leadership structure in collaboration with Deaf associations in Morocco's twelve regions to ensure meaningful community participation. Beyond linguistic research, this initiative also aims to raise awareness of MSL and improve educational resources for the Deaf community.

Strengthening documentation efforts can support the training of sign language teachers, interpreters, and educators, ultimately leading to the development of more effective teaching materials that reflect the linguistic diversity within the Moroccan Deaf community. These efforts are essential in narrowing the education and employment gaps between Deaf individuals and their hearing peers.

According to Morocco's High Commission of Planning's 2014 Census [2], 3.5% of the population (1,182,681 people) experience some degree of hearing loss. Among them, 0.2% (56,745 people) have profound hearing loss or total deafness, 1.0% (347,386 people) report significant difficulty hearing, and 2.3% (778,550 people) experience moderate difficulty.

Given these statistics, there is a clear need to expand both sign language use and Deaf education in Morocco. However, several obstacles hinder progress. A critical issue is the severe shortage of instructional resources, including textbooks, storybooks, and curriculum materials designed for Deaf students. In many classrooms, instruction relies heavily on copying text from a blackboard, often without ensuring that Deaf children comprehend the material. There is currently no evidence of educational materials that incorporate MSL to facilitate learning. Addressing these challenges requires a concerted effort to integrate MSL into education, improve resource availability, and foster greater inclusion for the Deaf community.

In this work, we present Madrasati-Signs[1], a web-based platform for building General and STEM vocabulary in MSL. Lessons learned from previous efforts to create community-driven online resources as well as other related work have been taken into account [3]–[8]. Our work is unique in that it accommodates regional variation and addresses one of the major challenges for crowdsourced sign language data, namely data quality and consistency; our regional contact points in Deaf associations/schools ensure the accuracy and reliability of the crowdsourced data. Our approach combines crowdsourcing with expert validation. We have also been building on earlier work [3] to integrate sign language data with other modalities by offering to users another input mode that enables them to use avatar technology to describe signs.

II. Related Work

Crowdsourcing has emerged as a powerful strategy for collecting sign language data by leveraging the contributions of native signers. This method plays a crucial role in addressing the scarcity of large, annotated datasets needed for machine learning applications, linguistic research, and assistive technologies. Given the diversity of sign languages and the relatively limited availability of standardized corpora, crowdsourcing offers a scalable and inclusive solution by engaging a wide range of participants across different regions and linguistic backgrounds. One of the most common approaches to crowdsourcing sign language data is video-based data collection, where volunteers contribute recorded samples of sign language. These datasets serve as valuable resources for automatic recognition systems, translation models, and linguistic studies. For instance, [9] created a dataset using webcam-recorded sign phrases, which was later used to train automatic sign language recognition (SLR) models. More recently, the How2Sign project [10] compiled a large-scale bilingual dataset (English-ASL) that includes not only video annotations but also pose tracking data, making it useful for both linguistic and computational applications. The dataset provides synchronized multi-modal annotations, allowing for better training of AI-driven sign language processing models.

Another approach involves the annotation of pre-existing sign language video datasets. Rather than collecting new video recordings, researchers leverage existing archives, adding linguistic, phonetic, and semantic metadata through crowdsourcing. For example, ASL-LEX [5] employs crowdsourcing to construct a lexical database where native signers provide insights into the frequency, complexity, and semantic properties of ASL signs. This approach ensures that linguistic characteristics, such as handshape, movement, and orientation, are well-documented. Similarly, SignBank, a digital sign language dictionary, relies on community contributions to expand its repository, allowing for the continuous growth of sign language resources.

Furthermore, sign language corpus projects, such as the NGT (Dutch) Corpus [11] and the British Sign Language Corpus Project [12], integrate crowdsourcing techniques to validate transcriptions and annotations, ensuring accuracy in glossing and phonetic representation. To enhance engagement and increase participation, some researchers have incorporated gamification elements and incentive-based platforms into the crowdsourcing process. Gamification transforms annotation tasks into interactive challenges, making data collection more dynamic and appealing. For example, Eudico Linguistic Annotator-based annotation games encourage volunteers to label and segment sign language clips using an intuitive, game-like interface. By integrating features such as leaderboards, badges, and progress tracking, these systems boost motivation and participation rates among contributors.

Additionally, platforms like Google's Crowdsource App explore gesture-based inputs to improve AI-driven gesture recognition models [13]. Some projects have experimented with token-based incentives, where participants receive rewards for completing annotation tasks, thus ensuring sustained engagement over time.

III. Madrasat-Signs: System Description

To support the lexical documentation of MSL, we developed Madrasati-Signs, a user-friendly online crowdsourcing platform that enables the Moroccan Deaf community to contribute to the creation of an MSL school dictionary [2]. The platform is designed with a strong focus on quality assurance, ensuring the reliability of documented signs. Users can log in and provide

[1]https://madrasati-signs.org/

[2]A demonstration of the Madrasati-Signs platform is available at the following link: https://www.youtube.com/watch?v=W5bIgNJ59qs

Figure 1: The Welcome page of Madrasati-Signs.

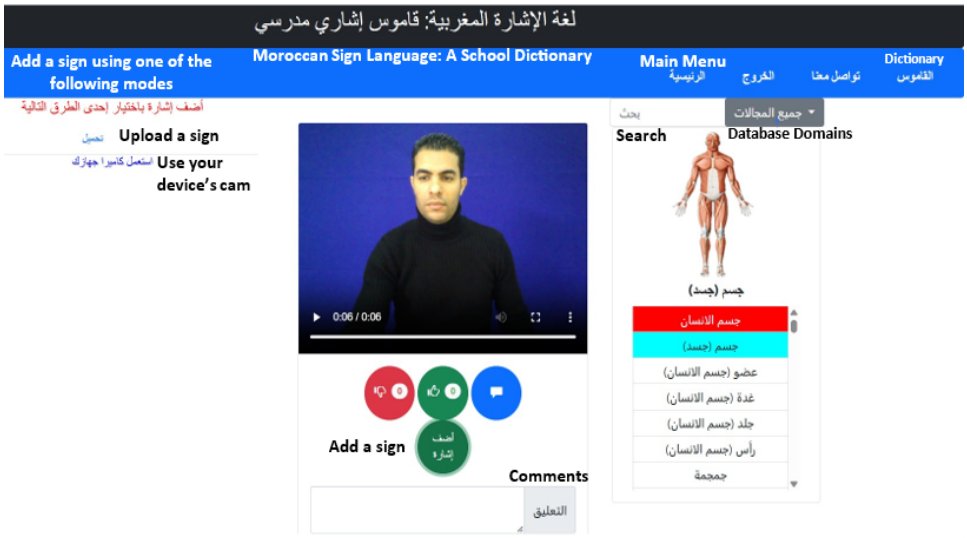

Figure 2: Madrasati-Signs Functionality and Crowdsourcing Input Modes [with English translations of some buttons].

demographic details, including their region and Deaf affiliation (e.g., Deaf individuals or Children of Deaf Adults (CODA)).

The platform's initial database consists of 3,000 words categorized into 21 thematic domains: family, colors, home, food, clothing, time, sports and hobbies, body, emotions, geography, transportation, education, nature and weather, animals, health, mathematics, business and careers, media and arts, technology, the alphabet, life sciences, and physics. The word selection is based on three key sources:

(1) An enhanced version of the MacArthur-Bates Communicative Development Inventory [14].
(2) Moroccan school textbooks, ensuring alignment with the national curriculum.
(3) STEM-related terms, identified through a needs analysis conducted with Deaf educators.

Whenever possible, each word is linked to a corresponding concept or image to aid comprehension. Users can contribute signs through one of two methods:

(1) Recording a video sign using a laptop, tablet, or phone camera. Upon providing consent, the device's camera is activated, and users are prompted to sign a given word. They can then review the recording and either approve it or re-record if needed.
(2) Uploading a pre-recorded video if an existing sign video is available.

This dual-input approach ensures flexibility and ease of participation, allowing for a more comprehensive and diverse documentation of MSL vocabulary. Fig. 1 shows the welcome page of Madrasati-Signs. Figure Fig. 2 shows a screenshot of the functionality of Madrasati-Signs and input modes. An English translation of some buttons is provided. The figure shows a Deaf signer from Rabat video recording the sign for the Arabic word **جسد** «body». A corresponding concept/image for this word is also shown.

Fig. 3 shows a group of Deaf signers and Deaf educators engaging in a discussion about specific STEM terms before recording their signs as part of a user study conducted in our lab.

Madrasati-Signs can accommodate the recording of multiple signs (if any) for each word. Where regional variations exist

Figure 3: A group of Deaf signers and educators discussing the sign for the term «solar panels» before recording it.

for a single sign, they are identified as (sign 1), (sign 2), and so forth. The platform is enhanced to include comments from the Deaf community and Deaf educators on crowdsourced signs. For quality assurance, sign contributions to the platform are overseen by experts from regional Deaf associations. For this purpose, we have established a local leadership structure paired with contacts at local Deaf associations in the twelve regions of Morocco, as indicated with pins on the map provided in Fig. 1. Our approach combines crowdsourcing with expert validation. Fig. 4 shows the number of video signs recorded for each of the 21 domains.

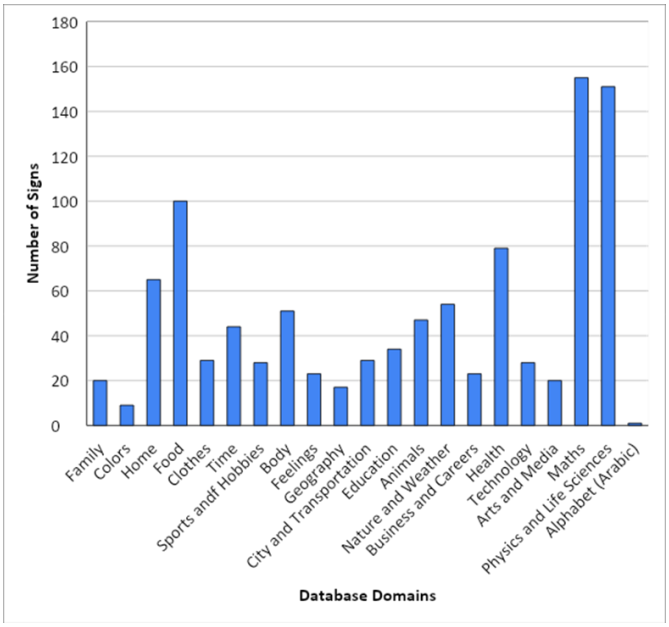

Figure 4: Signs collected so far for each of the 21 domains

Data collected so far indicate significant variation among signers both within and across regions, particularly in certain domains such as the numeral system. MSL numerals can be signed using either one hand or both hands. For instance, Fig. 5 illustrates differences in how signers express numerals combining units and tens. In the Rabat-Salé and Marrakech-Safi regions, signers begin with the unit followed by the ten, whereas in the Tangier-Tetouan-Al Hoceima and Fes-Meknès regions, the order is reversed, with the ten preceding the unit.

Interestingly, this variation in numeral structure mirrors patterns found in Morocco's spoken languages. In Amazigh, for numbers beyond twenty, the tens and units are combined by stating the ten first, followed by the conjunction "and", and then the unit. In contrast, both Standard Arabic and Moroccan Arabic follow the opposite order, placing the unit before the conjunction and then the ten.

(a) SIGN 38 in Fez-Meknès and Tangier Regions.

(b) SIGN 38 in Rabat-Salé and Marrakech Regions.

Figure 5: The numeral 38 in MSL

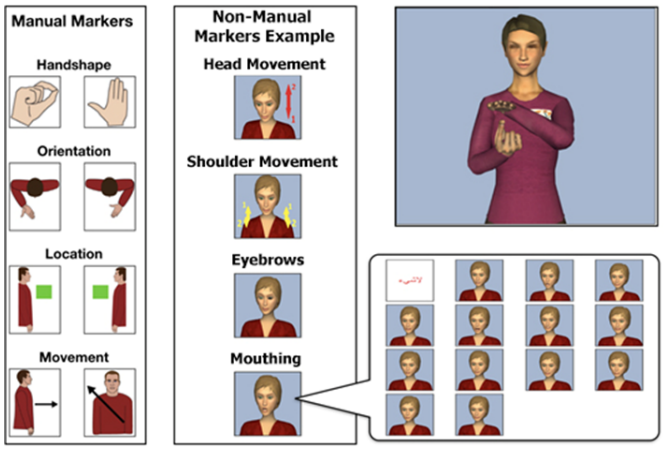

Figure 6: Users' sign depiction by choosing both manual and non-manual markers.

We are currently exploring the hypothesis that the regional variation in MSL numeral structure may be influenced by the dominant spoken language in each of Morocco's twelve regions. We are also incorporating another input mode that enables users to describe signs using an avatar in real time. Use of signing avatars offers several advantages. Unlike videos of human signers, animated signs offer several advantages: (1) they ensure anonymity, helping to avoid legal issues when published online, (2) they can be easily modified at any time, and (3) they consume significantly less bandwidth than video recordings. For this purpose, we have been experimenting with three options to be integrated into the platform Madrasati-Signs. The first option involves the use of a sign graphic menu that enables users to describe the sign by using both manual and non-manual markers: (1) manual markers/four cheremes (i.e., hand shape, location, movement, palm orientation) of each hand for the sign for which they want to find the spoken/written

language equivalent. Users can select these cheremes by using drop-down pictorial menus; (2) non-manual markers (e.g., head movement, facial expressions, mouthings). Users can select the non-manual marker type by using drop-down pictorial menus, as is shown in Fig. 6.

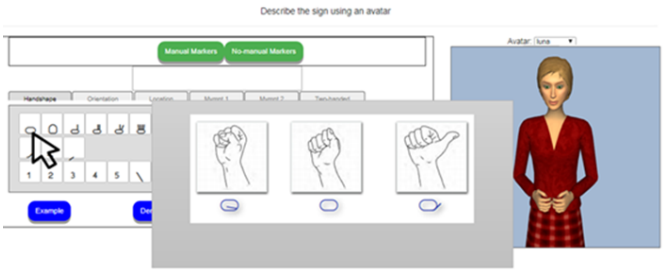

Figure 7: Simplified Sign Language Notation-based Keyboard.

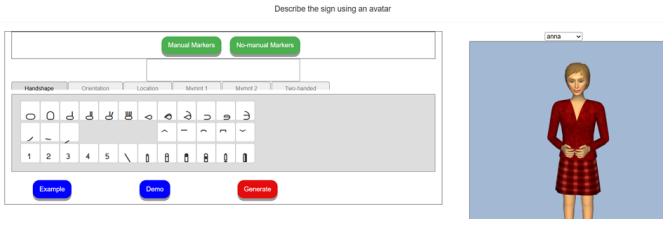

Figure 8: Expert Notation-based keyboard.

The second option we are exploring is the use of both a simplified and expert version of a sign language notation system as a keyboard. Building on early avatar technology works, we use an XML description language (SiGML) which is based on HamNoSys notation [15] and [16] gesture specification language (GessyCA). A system is developed to convert HamNoSys code of the given word to its SiGML form, to enable the animation of the avatar.

Fig. 7 shows a screenshot of the simplified version which, in addition to the notation symbols, includes pictorial menus of the cheremes [3]. Fig. 8, on the other hand, includes an advanced HamNoSys notation symbols and is meant for experts [4].

IV. Conclusion

In this paper, we presented Madrasati-Signs which aims at documenting and expanding MSL, particularly in STEM and general education. By leveraging crowdsourcing and expert validation, the platform enhances accessibility for the Moroccan Deaf community. Its ability to accommodate regional variations, integrate signing avatars, and provide multiple input modes ensures a more inclusive and flexible approach to sign language documentation. Additionally, by engaging local Deaf associations and educators across Morocco's twelve regions, the initiative fosters community participation and strengthens the quality of collected data. In addition to its educational benefits, Madrasati-Signs contributes to broader linguistic and social goals. As a resource for language preservation, it helps bridge the gap in sign language research, particularly for underrepresented languages like MSL. Its hybrid approach to crowdsourcing also addresses key challenges such as data consistency and accuracy. Furthermore, by aligning its vocabulary selection with national curricula and Deaf educators' needs, the platform directly supports the development of instructional materials, helping to improve Deaf education in Morocco. Madrasati-Signs holds promise for further innovation in sign language technology, including improved sign language notation systems and real-time avatar-based animation. Documenting MSL demands a strong long-term commitment, especially in view of the high literacy levels within the Deaf community.

[3]A demonstration of the simplified sign language notation keyboard can be viewed at: https://www.youtube.com/watch?v=LH5jcUNETMo

[4]A demonstration of the expert version is available at the following link: https://youtu.be/hTosEfAFnNU

References

[1] William C. Stokoe. 1960. Sign language structure: An outline of the visual communication systems of the american deaf. Journal of Deaf Studies and Deaf Education, 10(1):3–37.

[2] Z. El Ouazzani. 2015. Moroccan experience on disability statistics. Washington Group Meeting, Copenhagen, Denmark. Retrieved from https://www.cdc.gov/nchs/data/washington_group/meeting15/wg15_session_8_4_touahami.pdf.

[3] Abdelhadi Soudi, Kristof Van Laerhoven, and Elmostafa Bou-Souf. 2019. Africasign – a crowd-sourcing plat-form for the documentation of stem vocabulary in african sign languages. In Proceedings of the 21st International ACM SIGACCESS Conference on Computers and Accessibility, ASSETS'19, page 658–660, New York, NY, USA. Association for Computing Machinery.

[4] Abdelhadi Soudi and Corinne Vinopol. 2019. Educational challenges for deaf and hard-of-hearing children in morocco. Deaf education beyond the western world: Context, challenges, and prospects, pages 307–322.

[5] N Caselli, Z Sevcikova Sehyr, A M Cohen-Goldberg, and K Emmorey. 2017. Asl-lex: A lexical database of american sign language. Behavior Research Methods, 49(2):784–801.

[6] Danielle Bragg, Kyle Rector, and Richard E. Ladner. 2015. A user-powered american sign language dictionary. In Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing, CSCW '15, page 1837–1848, New York, NY, USA. Association for Computing Machinery.

[7] Jeanne Reis, Erin T. Solovey, Jon Henner, Kathleen Johnson, and Robert Hoffmeister. 2015. Asl clear: Stem education tools for deaf students. In Proceedings of the 17th International ACM SIGACCESS Conference on Computers & Accessibility, ASSETS '15, page 441–442, New York, NY, USA. Association for Computing Machinery.

[8] Vassilis Athitsos, Carol Neidle, Stan Sclaroff, Joan Nash, Alexandra Stefan, Quan Yuan, and Ashwin Thangali. 2008. The american sign language lexicon video dataset. In 2008 IEEE Computer Society Conference on Computer Vision and Pattern Recognition Workshops, pages 1–8.

[9] Oscar Koller, Jens Forster, and Hermann Ney. 2015. Continuous sign language recognition: Towards large vocabulary statistical recognition systems handling multiple signers. Computer Vision and Image Understanding, 141:108–125. Pose & Gesture.

[10] A. Duarte, S. Palaskar, L. Ventura, D. Ghadiyaram, K. DeHaan, F. Metze, J. Torres, and X. Giro-i Nieto. 2021. How2sign: A large-scale multimodal dataset for continuous american sign language. In Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR), pages 2735–2744.

[11] O. Crasborn, I. Zwitserlood, and J. Ros. 2008. The corpus ngt: An open access online corpus of movies and annotations of sign language of the netherlands. International Journal of Corpus Linguistics, 13(4):503–509.

[12] Adam Schembri, Jordan Fenlon, Ramas Rentelis, Sally Reynolds, and Kearsy Cormier. 2013. Building the british sign language corpus. Language Documentation and Conservation, 7:136–154.

[13] S. Sarin, K. Pipatsrisawat, K. Pham, A. Batra, and L. Valente. 2019. Crowdsource by google: A platform for collecting inclusive and representative machine learning data. In Proceedings of the AAAI Conference on Human Computation and Crowdsourcing (HCOMP).
[14] L. Fenson, V. A. Marchman, D. J. Thal, P. S. Dale, J. S. Reznick, and E. Bates. 2006. Macarthur-bates communicative development inventories, second edition (cdis) [database record].
[15] T Hanke and C Schmaling. 2001. A hamnosys-based phonetic transcription system as a basis for sign language generation. In Gesture Workshop 2001.
[16] Thierry Lebourque and Sylvie Gibet. 1999. High-level specification and control of communication gestures: The gessyca system. In Computer Animation, 1999. Proceedings, pages 24–35.