

# Investigation: Arabic and other sign languages based on Artificial techniques

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## Abstract

Sign language (SL) is the initial mode of communication that is used to communicate between Deaf communities around the world and normal people world, we noticed there are 200 and more different sign languages. For that, a lot of Researchers deal with sign language to be familiar and coexistence the deaf with others, it varies from one country to another, and even according to the regions, so many algorithms have been presented to translate the natural language to SL to learn deaf people according to their states, with one of these Sign languages (Arabic sign language ArSL) being discovered in the Arab World).

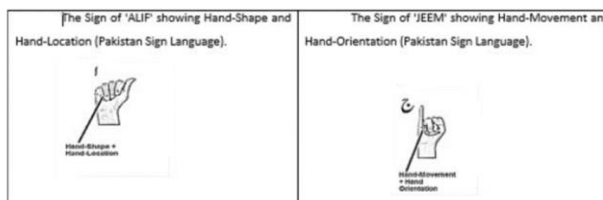
This paper will present state of art that deal with ArSL and some other techniques, it was only recently discovered and documented, and also the study classified the survey into hardware and software.

**Keywords:** Gesture recognition - Sign language – convolution neural network, Generative adversarial network

## 1- Introduction

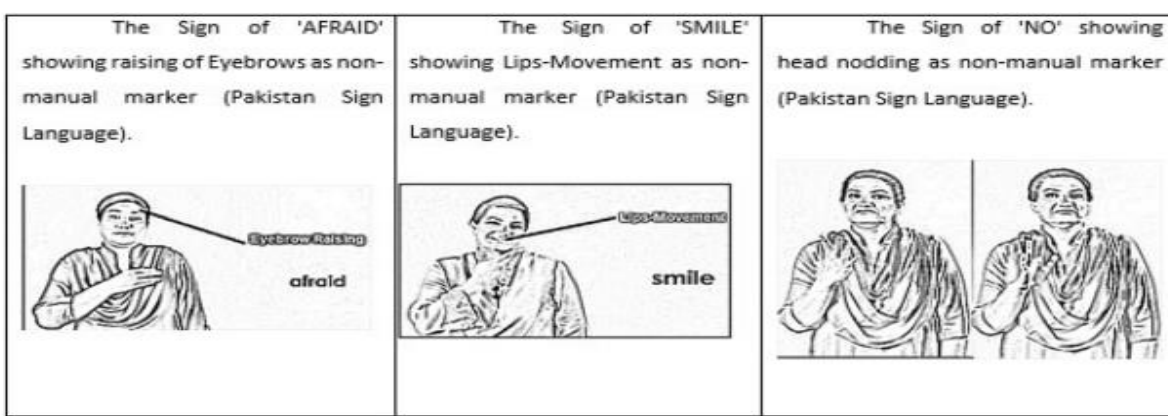
world's population suffering from hearing- impaired about 5% [1], this rate according to the World Health Organization, maybe seems small, but the later statistical provide that Hearing loss affects more than 460 million individuals worldwide, expected that by 2050 the number will be more than 900 million people some distributed in the United States, there are nearly 28 million people [2], In the Arab world, there are 17 million individuals [10].

In the Arabic world studies started recently to connect with deaf according to kind of their problem where found many types of hearing loss people in the range [0..11] years (1<sup>st</sup> dumbness from born this kind don't know how to read or write, 2<sup>nd</sup> deaf because accident liability this can read and so will easy to understand gesture) [1]. In Literature, most researchers considered two kinds of gestures: static and dynamic gestures, there are two types of features: 1st, manual features, automatic features (MF) 2nd Non-manual characteristics (NMF), which are illustrated in figure 1 (a) and (b).





(a): MF depends on the hand (shape, movement, location, and orientation). Some gestures are Performed by one hand, while others by both hands



(b): NMF depend on facial expressions, head nodding, shoulder raising, and mouth  
**Fig1** (a) MF, (b) NMF [1].

Deaf communities want to communicate and understand others here are an existed classrooms in many countries, trying to train, educate and learn them, fortunately, most of these classrooms are expensive to join, and far away from the residential areas, also the lack of interpreter numbers assumed the main obstacle for deaf students [3]. Another factor impeding SL recognition, translation, and product development is the lack of big annotated datasets. [4].

For that needs applications that help them increased day by day, developers pay great attention to design many applications help them to make communication with others, more techniques are used to convert the natural language to SL such as sensors (gloves, robots, ...etc.) and others used applications such as (convert text to sign and voice to sign).

In this study, we review and focus on ArSL and the algorithms that are used to solve these problems. The rest of this paper involved a section2 the history of ArSL, section3 Hardware-based approaches section4 Software-based approaches, section 5 machine learning techniques, section 6 Deep - learning techniques, section 7 Human interaction.

**2- History of sign language:** SL in Iraq appeared during the forties, while the history of alphabet gestures belongs to the 16<sup>th</sup> century in Spain, and in 1771 SL was in France and then separated to all of Europe and America [25].

Recently there have been systems proposed for the British Sign Language(BSL) and American Sign Language(ASL), while ArSL does not take the same interesting [ 6], the Arabic language is used by 300 million people in 20 different countries around the Middle East and North Africa (MENA), for that researcher started to developed and design systems can be used to communicate deaf or hard of hearing with other [7].

SL is not universal and represents the way by which hearing-disability or deaf people react with the normal community to understand them. In the past, SL was represented by simple signs, for example

in the Arabic gulf when the man refers to his chest that means white color (according to his clothes), while in other countries means his heart.

There are two types of strategies for dealing with deaf people's communication issues:

### 3. Hardware-based approaches

**a) Electronic gloves(EG):** in the 1970s this technology was invented for different uses Robotics, healthcare, and sign language recognition are just a few of the fields where this technology is being used, ER included many sensors and sources for power supply that help to gain data [8]. Gloves are worn on the hands when making gestures., 1983 Gary Grimes created the first data glove, intended for gesture recognition to assist the deaf community, including (the digital entry data glove, Cyber Glove, Light Glove, power glove, chording glove, and smart glove based on sensor types and positioning) [8], useful for the static and dynamic gesture, show figure (2)



**Fig.2** (a) The glove is made up of five 3-axis ACCs, (b) ten custom-built flex sensors, (c) five flex sensors mounted on the glove, LCD, and speaker, (d) three flex sensors used to detect a few movements [1].

**b) Robot:** There are two key arguments for choosing an expressive face for a social robot that performs SL. The major instrument of a social robot's natural interaction is body postures and gestures, and the non-manual component of the SL signs is primarily accomplished through facial expressions. Even though the amount of indicators with facial emotions is modest in comparison to those without, incorporating an expressive face into the robot will improve SL-based communication.

In [2011] used the algorithm to translate Arabic text to ASL that was performed by (Noa Humanoid) robot, this study clarifies which part of SL can be performed by a Robot and Find the common denominators between Arabic and ASL grammar to build good mapping for the middle parse tree [9].

While in [2019] TEO, a humanoid robot, is projected to automatically convey Spanish sign language by turning text into movements, based on neural network performance. The length discrepancy between the input and output data, as well as the use of non-manual markers, present various obstacles to developers when translating natural language to sign language. To avoid using traditional expert systems or overly sophisticated translation systems, neural networks, or sequence-to-sequence models, have been chosen as a data-driven solution [10], and in [2019] produced RASA is a nonprofit organization dedicated to preventing (Robot Assistant for Social Aims). This

educational social robot was created to help youngsters with hearing impairments learn Persian Sign Language (PSL). Inspected recognition rates also reported [11].

#### **4. Software-based approaches**

These approaches consider in the field of computer vision, they rely on digital image and video processing while recognizing gestures using machine learning and deep learning methodologies. For training and testing, it uses pictures or video data sets. Software-based techniques have the potential to be extremely effective. classified in to (1) Backpropagation - Neural Network (BNN) is a probabilistic approach for recognizing Dynamic Malaysian Sign Language (MSL).

The 2015[12] system has five steps (the first stage obtains picture capture data from the Kinect sensor, which is then used to track skeletal data with eight joint positions). The skeletal feature extraction is done in the second step, the value of coordinate X, Y, Z spherical coordinate conversion procedure is done in the third stage, and the frame segmentation is done in the fourth stage to get the same number of dimensions. This system was able to distinguish 15 dynamic MSL with 80.54 percent accuracy in the final stage classification procedure using BNN. (2) Approaches based on machine learning or deep learning. Convolution Neural Network CNN and avatar are examples.

In 2020[13] used "Android Studio" as a development environment to create apps that run on Android-based devices. This study intends to create an app for social communication and learning by translating (Iraqi sign language) into Arabic text and vice versa, applied to the student of the al-Amal institute in Mosul and the result was satisfying.

In 2011[14] they allowed the user to engage with the system naturally by dealing with photographs of bare hands as an automatic translation system (ArSLAT) for gestures of manual alphabets. There are five primary stages in this proposed system (1st pre-processing phase, 2nd best-frame detection phase, 3rd category detection phase, 4th feature extraction phase, and finally classification phase). Translation, scaling, and rotation invariant characteristics were extracted to make the system more adaptable. Minimum distance classifier (MDC) and multilayer perceptron (MLP) classifiers were used. with an accuracy of 91.3% and 83.7%, respectively.

The next paragraph displays some of the techniques that are used to convert (voice, text) to SL.

#### **5. Machine Learning techniques:**

In recent years, the role of pattern recognition in human-computer interaction (HCI) systems has grown in terms of computer vision applications and machine learning, with one of the most important of these applications being the recognition of hand gestures used in dealing with deaf people [6].

In [2021] propose an Arabic Alphabet Sign Language Recognition System (AArSLRS) based on vision, system that has been proposed comprises of four stages: (data processing, data preprocessing, feature extraction, and classification), with three sorts of datasets: data dealing with naked hands and dark background, data dealing with bare hands but a light background, and data dealing with bare hands but a light background data and context interacting with dark-gloved hands Obtaining a picture of the alphabet is the first step in AArSLRS. using one of the recommended approaches, then revealing the hand from the image and isolating it from the background which hand traits are extracted based on the extraction procedure When it comes to categorization, For the classification of the 28-letter Arabic alphabet using 9240 photos, applied supervised learning approaches in the system. In the Quranic sign language, they focused on classifying 14 alphabetic letters that represent the first Quran surah's (QSL). For the K-Nearest Neighbor (KNN) classifier, AArSLRS attained an accuracy of 99.5 percent [5].

Many scholars and businesses are working to improve deaf people's access to science in various parts of their lives. Except for stages that must be completed with just 10 integer numeric values or that are required, this proposal created a Kurdish sign language system based on written and spoken translation techniques.

The suggested framework is divided into three phases: video processing, pattern formation and discrimination, and text translation. This technique is based on the signature gesture of a subject expert and a translator's structure trained in Kurdish sign language, mostly conventional Kurdish sign language. The KArSL database for ArSL is described in this article, and it contains 502 signs that cover 11 parts of a ArSL dictionary. Three major signers perform the signs in the KArSL database, and each sign is performed 50 times by each signer. The dataset was developed with the reducing multi-modal Microsoft Kinect V2. The methods are also tested on a publicly available database. The KArSL database will be made freely available to anybody who is interested [15].

In [2020] attempt to construct a computerized system that uses depth-measuring cameras and computer vision algorithms to capture and segment images of facial emotions and hand gestures. Following their recognition and linking with their corresponding spoken and written Arabic words, the segmentation gestures are categorized and stored in an electronic library. Gestures and their accompanying spoken and written Arabic words will be used to teach the computerized system. The method was tested using a gesture dataset of 40 segmented words that hearing-impaired people regularly employ in their daily lives. each word may have a distinct occlusion status as a result of consideration. The results of the experiments showed that the suggested system has a recognition accuracy of more than 90% [16].

## **6. Deep Learning methods**

Deep learning technology is more accurate than machine learning and neural network and automated SL recognition based on machine/deep learning methods [17,18]. Deep learning entails a variety of methodologies and algorithms for working with deaf people:

### **6.1. Network Convolution Neural (CNN)**

searchers discussed or involved the research about CNN because of founding more accurate than other techniques. In 2020 solved the problem of the (Translation and understanding of sign language) by using ontology on the SL domain to solve various SL difficulties, offering an ArSL translation system using ontology and deep learning techniques, rudimentary static signs consisting of Arabic alphabets, and some Arabic phrases started to translate (CNN) The architecture was trained and evaluated using a pre-made ArSL dataset, resulting in higher recognition accuracy in the testing set, which was 94.31 percent [21].

in 2019 [22] for static SL deep learning This system uses a skin-color modeling technique to recognize people, the skin-color range has been predetermined to separate pixels (hand) from non-pixels (background). For image categorization, the images were loaded into a model called the (CNN). The system achieved an average testing accuracy of 93.67 percent, with ASL alphabet recognition accounting for 90.04 percent, number recognition accounting for 93.44 percent, and static word recognition accounting for 97.52 percent.

### **6.2 generative adversarial networks (GAN)**

[23] proposed a new method to create sign videos using spoken language, the approach supports the system by using Training annotations with a low gloss and skeletal level, then using broadcast quality assessment standards, show the video creation capabilities in both multi-signer and high-

definition settings in both qualitative and quantitative terms, the posture maps are being created (0.77 s/gloss).

While [24] Using a modified Info GAN approach, a novel model for generating Bangla Sign Digit pictures was presented. This model has a 13-layer network design with an input layer, dense layer, convolutional layer, transpose convolutional layer, activation, and batch normalization layer that reduces the loss function, computation power, and produces no distorted images like actual ones. Tanh and ReLU are utilized as activation functions. The model score for this method is 8.77, which is rather impressive for a generation model.

## 7- Human interaction

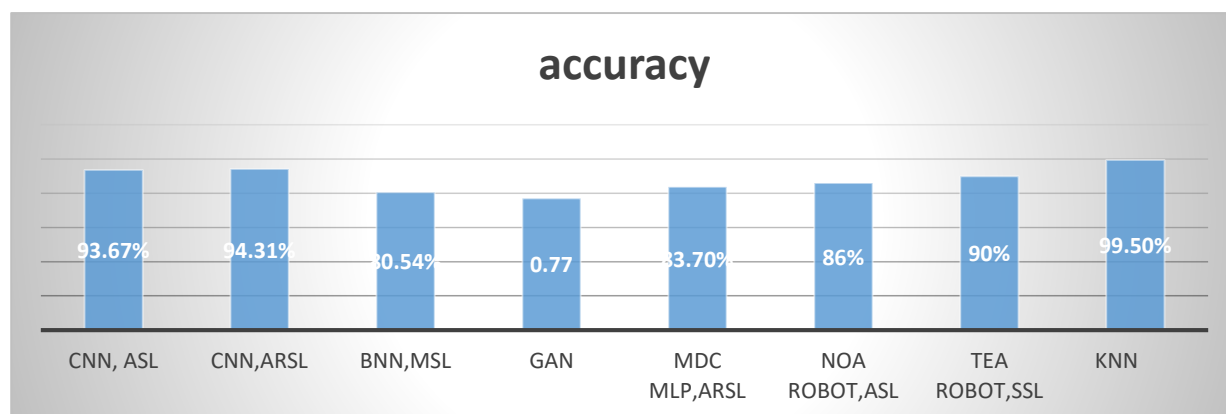
There are three types of Human interaction (Avatar technology, Neural machine translation, and Artificial neural network). Where in 2021 using 3D-Avatar technology for the eSign editor software was used to translate Arabic words into the Hamburg notation system, which was used to create an ArSL lexicon as part of a translation system. The sign is then converted to a SiGML file, and the 3D avatar reads the SiGML file scripts to create an animated sign. [20]. Table (1) illustrated an important up-to-date study in ArSL.

**Table 1: the techniques used in Arabic sign language**

No.	Author /year /No. ref	Methodology	Process	Data set	Accuracy
1.	Ahmed H. Aliwy, Ahmed A.Alethary / 2021 / 20	3D avatar to develop Dictionary of Arabic sign language ArSL	eSign editor Software	ArSL	satisfied
2.	Miaad Ahmed Alobaidy, Sundus Khaleel Ebraheem /2020 / 13	Android Studio Java language	translating Iraqi sign language into text in Arabic	Iraqi sign language	Applied on the student of al-Amal institute in Mosul and the result is satisfied
3.	Ghazanfar Latif , Jaafar Alghazo etc. / 2021 / 19	an automatic Artificial Intelligence (AI)	Random Forest (RF), Bagging Classifier (BT), Regression, and Random Tree (RT) are used	ArSLT	92.15%,453, 87.63% 80.87%, 82.57%
4.	Nashwa El-Bendary , Hossam M. Zawbaa /2011 / 14	MDC MLP deals with images of bare hands, which allows the user to interact with the system in a natural way	Pre-processing, best-frame detection, category detection, feature extraction, and classification are the five primary steps of the system.	ArSL	83.7%
5.	Gamal Tharwat Abdelmoty M. Ahmed , etc. / 2020 / 5	(KNN) classifier	data processing, data preprocessing, feature extraction, and classification	AArSLR S	99.5%
6.	Eman K. Elsayed , Doaa R. Fathy /2020 /21	Ontology and deep-learning techniques CNN	building ontology-based, combining ontology with deep learning	Ar SL	94.31%.

## 8-Discussion and Result

Sign language for the hearing-impaired is the best way to communicate between their society and other societies, and many researchers have addressed this topic because of its paramount importance to deal and cooperate in finding an easy and accurate way to communicate with deaf groups, in this study we presented several techniques that deal with SL, by using H/W, S/W, machine learning, and deep learning, then focused on ArSL, and the Iraqi sign language was touched upon due to its lack of application like other Arab countries, We note that some use machine learning if the data is limited such as (dictionaries) which used to learn in schools for the deaf, and it was quick to implement and with accurate results. And the other section used deep learning if the data was large and needed high accuracy, where the result of CNN was more accurate than other techniques, the GAN technique its modern deep learning method ,and its result satisfaction, also we noticed limitations of previous methods that used ArSL that just alphabets, not only with words but also with finger writing and other motions for the dataset, a small number of photos were used. figure (3) displays the different SL researches and their accuracy. Finally, the methods that translation spoken and written words into SL is still incomplete



**Figure 3** Chart of methods used in different SL researches and their accuracy

## 9-CONCLUSION

Countries in the developed world have been provided their deaf population with tools and technologies to make life easier for them during connection with others and increase their cognitive and sensory loss. People who suffer from hearing disabilities can be helped in different ways. (Medically, an early diagnosis, use of hearing, also ways of educational and social support are used to address this problem like information technology-based solutions, these solutions involve dictionaries and repositories to learn a sign language, translation systems that aim to convert voice or text into sign language gestures using avatar technology, recognize gestures and produce natural language text or voice. and we find a lack in Arabic search, especially in Iraqi SL.

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## REFERENCES

1. Stoll, S., Camgöz, N. C., Hadfield, S., & Bowden, R. (2018, September). Sign language production using neural machine translation and generative adversarial networks. In Proceedings of the 29th British Machine Vision Conference (BMVC 2018). University of Surrey.
2. Elsayed, E. K., & Fathy, D. R.(2020). Sign language semantic translation system using ontology and deep learning. International Journal of Advanced Computer Science and Applications, 11.
3. Alasim, K. (2021). Inclusion and d/Deaf and hard of hearing students: A qualitative meta-analysis. International Journal of Disability, Development and Education, 1-27.
4. Duarte, A., Palaskar, S., Ventura, L., Ghadiyaram, D., DeHaan, K., Metze, F., ... & Giro-i-Nieto, X. (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 (pp. 2735-2744).
5. Tharwat, G., Ahmed, A. M., & Bouallegue, B. (2021). Arabic Sign Language Recognition System for Alphabets Using Machine Learning Techniques. Journal of Electrical and Computer Engineering, 2021.
6. Latif, G., Alghazo, J., Mohammad, N., & Alghazo, R. (2021, July). Communicating with the Deaf and Hard of Hearing through Automatic Arabic Sign Language Translator. In Journal of Physics: Conference Series (Vol. 1962, No. 1, p. 012055). IOP Publishing.
7. Dipietro L, Sabatini AM, Dario P (2008) A survey of glove-based systems and their applications. IEEE Trans Syst Man Cybern Part C (Appl Rev) 38(4):461-482
8. Grimes GJ (1983) Digital data entry glove interface device, 8 Nov 1983. US Patent 4,414,537
9. Stoll, S., Camgoz, N. C., Hadfield, S., & Bowden, R. (2020). Text2Sign: Towards sign language production using neural machine translation and generative adversarial networks. International Journal of Computer Vision, 128(4), 891-908.

10. Mohameed, R. A., Naji, R. M., Ahmeed, A. M., Saeed, D. A., & Mosleh, M. A. (2021, August). Automated translation for Yemeni's Sign Language to Text Using Transfer Learning-based Convolutional Neural Networks. In 2021 1st International Conference on Emerging Smart Technologies and Applications (eSmarTA) (pp. 1-5). IEEE
11. Meghdari, A., Alemi, M., Zakipour, M., & Kashanian, S. A. (2019). Design and realization of a sign language educational humanoid robot. *Journal of Intelligent & Robotic Systems*, 95(1), 3-17.
12. Majid, M. B. A., Zain, J. B. M., & Hermawan, A. (2015, October). Recognition of Malaysian sign language using skeleton data with a network. In 2015 International Conference on Science in Information Technology (ICSITech) (pp. 231-236). IEEE.
13. Alobaidy, M. A., & Sundus, K. E. (2020). Application for Iraqi sign language translation on Android system. *International Journal of Electrical and Computer Engineering*, 10(5), 5227.
14. Tolentino, L. K. S., Juan, R. O. S., Thio-ac, A. C., Pamahoy, M. A. B., Forteza, J. R. R., & Garcia, X. J. O. (2019). Static sign language recognition using deep learning. *International Journal of Machine Learning and Computing*, 9(6), 821-827.
15. Sidig, A. A. I., Luqman, H., Mahmoud, S., & Mohandes, M. (2021). KArSL: Arabic Sign Language Database. *ACM Transactions on Asian and Low-Resource Language Information Processing (TALLIP)*, 20(1), 119.
16. Mohamed, M. M. (2020). Automatic system for Arabic sign language recognition and translation to spoken one. *International Journal*, 9(5), 7140-7148
17. Liu, L., Ouyang, W., Wang, X., Fieguth, P., Chen, J., Liu, X., & Pietikäinen, M. (2020). Deep learning for generic object detection: A survey. *International journal of computer vision*, 128(2), 261-318.
18. Al-Qurishi, M., Khalid, T., & Souissi, R. (2021). Deep Learning for Sign Language Recognition: Current Techniques, Benchmarks, and Open Issues. *IEEE Access*.
19. Latif, G., Alghazo, J., Mohammad, N., & Alghazo, R. (2021, July). Communicating with the Deaf and Hard of Hearing through Automatic Arabic Sign Language Translator. In *Journal of Physics: Conference Series* (Vol. 1962, No. 1, p. 012055). IOP Publishing.
20. Aliwy, A.H., & Ahmed, A. A. (2021). Development of arabic sign language dictionary using 3D avatar technologies. *Indonesian Journal of Electrical Engineering and Computer Science*, 21(1), 609-616.
21. Elsayed, E. K., & Fathy, D. R. (2020). Sign language semantic translation system using ontology and deep learning. *International Journal of Advanced Computer Science and Applications*, 11.
22. El-Bendary, N., Zawbaa, H. M., Daoud, M. S., Hassanien, A. E., & Nakamatsu, K. (2010, October). Arslat: Arabic sign language alphabets translator. In 2010 international conference on computer information systems and industrial management applications (CISIM) (pp. 590-595). IEEE.
23. Grimes GJ (1983) Digital data entry glove interface device, 8 Nov 1983. US Patent 4,414,537
24. Shishir, F. S., Hossain, T., & Shah, F. M. (2020, June). EsharaGAN: An Approach to Generate Disentangle Representation of Sign Language using InfoGAN. In 2020 IEEE Region 10 Symposium (TENSYMP) (pp. 1383-1386). IEEE.
25. ميهان فتاح محمد, مديحة فرج ابراهيم, نوال جهاد, ازهار ميرز -القاموس الاشاري المدرسي للصم لسنة (2008/1428) جمهورية العراق / وزارة العمل والشؤون الاجتماعية -دائرة ذوي الاحتياجات الخاصة