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Sign Language Recognition System Using Convolutional Neural Network

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ABSTRACT: Very few people understand sign language as it is not an international language. This makes it difficult for the majority of hearing communities to communicate with the deaf community. Hence automatic recognition system is a new way of understanding the meaning of deaf signs without needing the help of expert. This technique can be used to translate signs into texts based on the users' needs. In this paper, we are recognizing the signs through the hand gestures using Convolution Neural Network (CNN) from the deep learning and with the help of OpenCV. Here, CNN is used to train the dataset and OpenCV is used to capture the hand gestures. In this proposed model we are mainly recognizing the numerical sign hand gestures.

KEYWORDS: Hand gestures, deep learning, CNN, OpenCV

I. INTRODUCTION

Sign languages (also known as signed languages) are languages that use the visual-manual modality to convey meaning. Sign languages are expressed through manual articulations in combination with non-manual elements. Sign languages are full-fledged natural languages with their own grammar and lexicon. Sign languages are not universal and they are not mutually intelligible with each other, although there are also striking similarities among sign languages. Linguists consider both spoken and signed communication to be types of natural language, meaning that both emerged through an abstract, protracted aging process and evolved over time without meticulous planning. Sign language should not be confused with body language, a type of nonverbal communication.

Wherever communities of deaf people exist, sign languages have developed as useful means of communication, and they form the core of local Deaf cultures. Although signing is used primarily by the deaf and hard of hearing, it is also used by hearing individuals, such as those unable to physically speak, those who have trouble with spoken language due to a disability or condition (augmentative and alternative communication), or those with deaf family members, such as children of deaf adults.

It is unclear how many sign languages currently exist worldwide. Each country generally has its own native sign language, and some have more than one. The 2020 edition of Ethnologue lists 144 sign languages, while the SIGN-HUB Atlas of Sign Language Structures lists over 200 of them and notes that there are more which have not been documented or discovered yet.

Some sign languages have obtained some form of legal recognition. Linguists distinguish natural sign languages from other systems that are precursors to them or obtained from them, such as invented manual codes for spoken languages, home sign, "baby sign", and signs learned by non-human primates.

Classification

Although sign languages have emerged naturally in deaf communities alongside or among spoken languages, they are unrelated to spoken languages and have different grammatical structures at their core. Sign languages may be classified by how they arise.

In non-signing communities, home sign is not a full language, but closer to a pidgin. Home sign is amorphous and generally idiosyncratic to a particular family, where a deaf child does not have contact with other deaf children and is

not educated in sign. Such systems are not generally passed on from one generation to the next. Where they are passed on, creolization would be expected to occur, resulting in a full language. However, home sign may also be closer to full language in communities where the hearing population has a gestural mode of language; examples include various Australian Aboriginal sign languages and gestural systems across West Africa, such as Mofu-Gudur in Cameroon.

A village sign language is a local indigenous language that typically arises over several generations in a relatively insular community with a high incidence of deafness, and is used both by the deaf and by a significant portion of the hearing community, who have deaf family and friends. The most famous of these is probably the extinct Martha's Vineyard Sign Language of the US, but there are also numerous village languages scattered throughout Africa, Asia, and America.

Deaf-community sign languages, on the other hand, arise where deaf people come together to form their own communities. These include school sign, such as Nicaraguan Sign Language, which develop in the student bodies of deaf schools which do not use sign as a language of instruction, as well as community languages such as Bamako Sign Language, which arise where generally uneducated deaf people congregate in urban centers for employment. At first, Deaf-community sign languages are not generally known by the hearing population, in many cases not even by close family members. However, they may grow, in some cases becoming a language of instruction and receiving official recognition, as in the case of ASL.

Both contrast with speech-taboo languages such as the various Aboriginal Australian sign languages, which are developed by the hearing community and only used secondarily by the deaf. It is doubtful whether most of these are languages in their own right, rather than manual codes of spoken languages, though a few such as Yolngu Sign Language are independent of any particular spoken language. Hearing people may also develop sign to communicate with users of other languages, as in Plains Indian Sign Language; this was a contact signing system or pidgin that was evidently not used by deaf people in the Plains nations, though it presumably influenced home sign.

Language contact and creolization is common in the development of sign languages, making clear family classifications difficult – it is often unclear whether lexical similarity is due to borrowing or a common parent language, or whether there was one or several parent languages, such as several village languages merging into a Deaf-community language. Contact occurs between sign languages, between sign and spoken languages (contact sign, a kind of pidgin), and between sign languages and gestural systems used by the broader community. One author has speculated that Adamorobe Sign Language, a village sign language of Ghana, may be related to the "gestural trade jargon used in the markets throughout West Africa", in vocabulary and areal features including prosody and phonetics.

Typology

Linguistic typology (going back to Edward Sapir) is based on word structure and distinguishes morphological classes such as agglutinating/concatenating, inflectional, polysynthetic, incorporating, and isolating ones. Sign languages vary in word-order typology. For example, Austrian Sign Language, Japanese Sign Language and Indo-Pakistani Sign Language are Subject-object-verb while ASL is Subject-verb-object. Influence from the surrounding spoken languages is not improbable.

Sign languages tend to be incorporating classifier languages, where a classifier hand shape representing the object is incorporated into those transitive verbs which allow such modification. For a similar group of intransitive verbs (especially motion verbs), it is the subject which is incorporated. Only in a very few sign languages (for instance Japanese Sign Language) are agents ever incorporated. In this way, since subjects of intransitives are treated similarly to objects of transitives, incorporation in sign languages can be said to follow an ergative pattern.

Brentari classifies sign languages as a whole group determined by the medium of communication (visual instead of auditory) as one group with the features monosyllabic and polymorphemic. That means, that one syllable (i.e. one word, one sign) can express several morphemes, e.g., subject and object of a verb determine the direction of the verb's movement (inflection).

Acquisition

Children who are exposed to a sign language from birth will acquire it, just as hearing children acquire their native spoken language. The Critical Period hypothesis suggests that language, spoken or signed, is more easily acquired as a child at a young age versus an adult because of the plasticity of the child's brain. In a study done at the University of

McGill, they found that American Sign Language users who acquired the language natively (from birth) performed better when asked to copy videos of ASL sentences than ASL users who acquired the language later in life. They also found that there are differences in the grammatical morphology of ASL sentences between the two groups, all suggesting that there is a very important critical period in learning signed languages.

Sign perception

For a native signer, sign perception influences how the mind makes sense of their visual language experience. For example, a hand shape may vary based on the other signs made before or after it, but these variations are arranged in perceptual categories during its development. The mind detects hand shape contrasts but group's similar handshapes together in one category. Different handshapes are stored in other categories. The mind ignores some of the similarities between different perceptual categories, at the same time preserving the visual information within each perceptual category of hand shape variation.

Written forms

Sign languages do not have a traditional or formal written form. Many deaf people do not see a need to write their own language. Several ways to represent sign languages in written form have been developed.

- Stokoe notation, devised by Dr. William Stokoe for his 1965 Dictionary of American Sign Language, is an abstract phonemic notation system. Designed specifically for representing the use of the hands, it has no way of expressing facial expression or other non-manual features of sign languages. However, it was designed for research, particularly in a dictionary, not for general use.
- The Hamburg Notation System (HamNoSys), developed in the early 1990s, is a detailed phonetic system, not designed for any one sign language, and intended as a transcription system for researchers rather than as a practical script.
- David J. Peterson has attempted to create a phonetic transcription system for signing that is ASCII-friendly known as the Sign Language International Phonetic Alphabet (SLIPA).
- SignWriting, developed by Valerie Sutton in 1974, is a system for representing sign languages phonetically (including mouthing, facial expression and dynamics of movement). The script is sometimes used for detailed research, language documentation, as well as publishing texts and works in sign languages.
- si5s is another orthography which is largely phonemic. However, a few signs are logographs and/or ideographs due to regional variation in sign languages.

II. EXISTING METHOD

This model emphasizes an existing method that which is designed using a low-cost depth camera, which is Microsoft's Kinect. A segmented hand configuration is first obtained by using a depth contrast feature based per-pixel classification algorithm. Then, a hierarchical mode-seeking method is developed and implemented to localize hand joint positions under kinematic constraints. Finally, a Random Forest (RF) classifier is built to recognize ASL signs using the joint angles.

Disadvantages:

- Low accuracy
- Lesser prediction
- Time consuming

III. PROPOSED METHOD

The proposed model emphasizes a deep network architecture that which is used to recognize the signs through the hand gestures those which are numeric gestures using Convolution Neural Network (CNN) from the deep learning and with the help of OpenCV. Here, CNN is used to train the dataset and OpenCV is used to capture the hand gestures. As very few people understand sign language as it is not an international language. This makes it difficult for the majority of hearing communities to communicate with the deaf community. Hence automatic recognition system is a new way of understanding the meaning of deaf signs without needing the help of expert. Where, our proposed model can be used to recognize the signs. The block diagram of the proposed system is shown in below diagram.

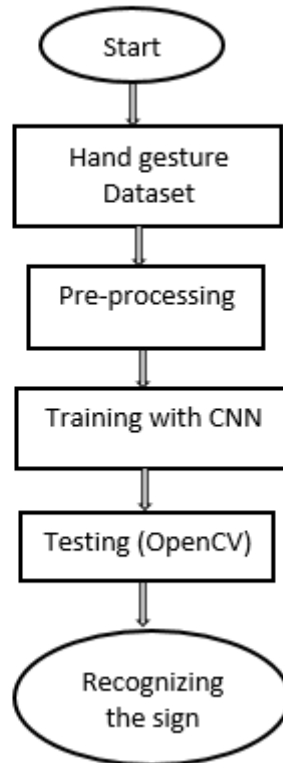


Fig 1. Block diagram of proposed method

Advantages:

- High feature compatibility
- Time Saving
- Low complexities

APPLICATIONS

- Helping deaf-mute people

**SYSTEM SPECIFICATIONS
HARDWARE & SOFTWARE REQUIREMENTS**

H/W Configuration:

- Processor : I3/Intel Processor
- Hard Disk : 160GB
- RAM :8Gb

S/W Configuration:

- Operating System : Windows 7/8/10
- IDE : Pycharm.
- Libraries Used : Numpy, IO, OS, OpenCV.
- Technology : Python 3.6+.

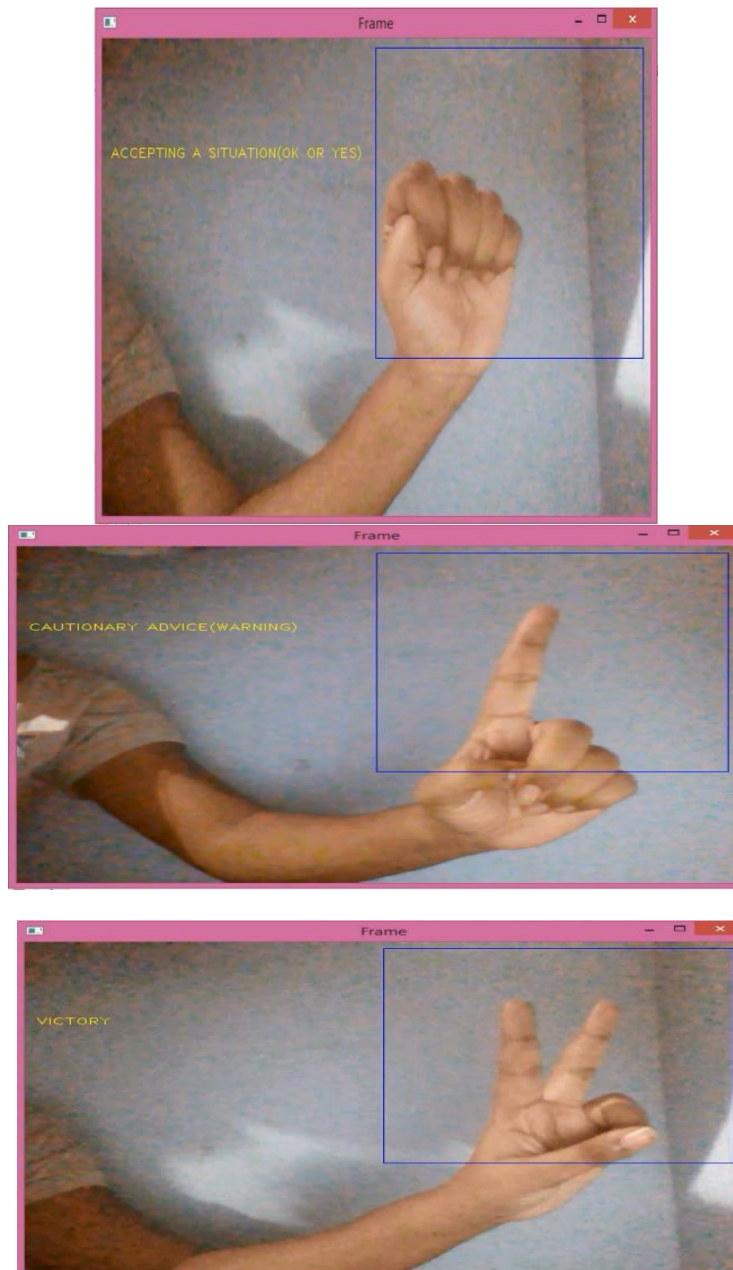
Goals:

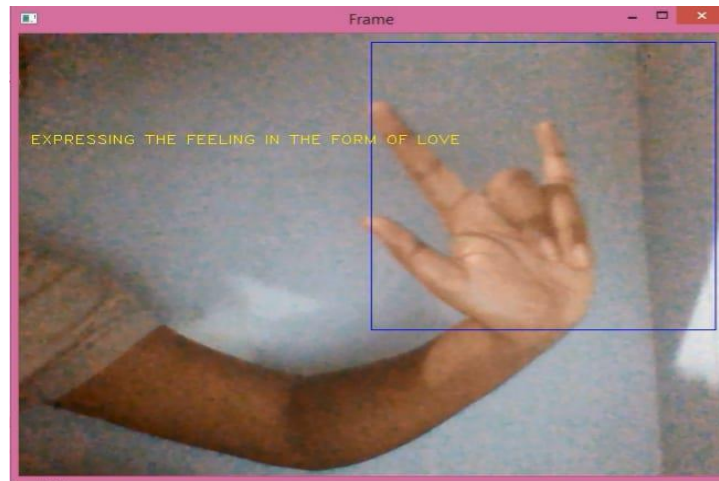
The Primary goals in the design of the UML are as follows:

1. Provide users a ready-to-use, expressive visual modeling Language so that they can develop and exchange meaningful models.
2. Provide extendibility and specialization mechanisms to extend the core concepts.

3. Be independent of particular programming languages and development process.
4. Provide a formal basis for understanding the modeling language.
5. Encourage the growth of OO tools market.
6. Support higher level development concepts such as collaborations, frameworks, patterns and components.
7. Integrate best practices.

IV. RESULTS





V. CONCLUSION

In our proposed model we recognized the signs through the hand gestures using Convolution Neural Network (CNN) from the deep learning and with the help of OpenCV. We considered a dataset with the hand gestures those which are numeric gestures, and trained using the CNN algorithm of deep learning. Once the training is completed, we used OpenCV that which recognizes the hand gestures of numerical signs.

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