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TRANSLATION OF SIGN LANGUAGE SYSTEM

A project present to multimedia dep. College of Computer Science and Information Technology as a partial fulfillment of requirement for the degree of B.S.c in computer science.

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شكر وتقدير

الحمدالله الأول قبل الانشاء و الاخر بعد فناء الأشياء ، و الصلاة و السلام على سيدنا محمد و آل بيته الطيبين الطاهرين

لابد لنا ونحن نخطو خطواتنا الأخيرة في الحياة الجامعية من وقفة نعود إلى أعوام قضيناها في رحاب الجامعة مع أساتذتنا الكرام الذين قدموا لنا الكثير باذلين بذلك جهودا كبيرة في بناء جيل الغد لتبعث الأمة من جديد .وقبل أن نمضي نقدم أسمى آيات الشكر والامتنان والتقدير والمحبة إلى الذين حملوا أقدس رسالة في الحياة.إلى الذين مهدوا لنا طريق العلم والمعرفة...   إلى جميع أساتذتنا الأفاضل.......

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الدكتورة سلوى رئيس قسم الوسائط المتعددة والأستاذ محمد اقبال مقرر القسم والدكتور علي محسن و الدكتور ضياء الذين قدموا لنا العون و جعلونا ممن نفتخر بهم فجزيل الشكر و الامتنان لكم

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و في الختام اسال الله العلي القدير ان يكون هذا العمل خالصاً لوجه ، و ان يجعله علماً نافعاً

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إلى من بلغ الرسالة وأدى الأمانة .. ونصح الأمة .. إلى نبي الرحمة ونور العالمين

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بِسْمِ اللَّهِ الرَّحْمَٰنِ الرَّحِيمِ

﴿ يَرْفَعِ اللَّهُ الَّذِينَ ءَامَنُوا۟ مِنكُمْ وَالَّذِينَ أُوتُوا۟ الْعِلْمَ دَرَجَٰتٍ ۚ وَاللَّهُ بِمَا تَعْمَلُونَ خَبِيرٌ ﴾

صَدَقَ اللَّهُ الْعَلِيُّ الْعَظِيمُ

المجادلة: ١١

Abstract

One of the major drawback of our society is the barrier that is created between disabled or handicapped persons and the normal person. Communication is the only medium by which we can share our thoughts or convey the message but for a person with disability (deaf and dumb) faces difficulty in communication with normal person. For many deaf and dumb people . where This research deals with the identification of sign language and the method of communication between handicapped persons and normal persons, sign language is the basic means of communication. Sign language recognition (SLR) aims to interpret sign languages automatically by a computer in order to help the deaf communicate with hearing society conveniently. Our aim is to design a system to help the person who trained the hearing impaired to communicate with the rest of the world using sign language or hand gesture recognition techniques. In this system, feature detection and feature extraction of hand gesture is done with the help of algorithm using image processing. All this work is done using MATLAB software. With the help of this algorithm, a person can easily trained a deaf and dumb.

This research contains three chapters. The first chapter deals briefly with the Matlab program, general image processing and image processing within the Matlab environment. The second chapter deals with speech about the sign language, its history, its significance for the deaf and dumb, and the techniques of sign language and translation. Automatic language and some types of sign language with the explanation of American sign language. The research in Chapter 3 deals with the way the program works in detail and the suggestions that can be added to the program.where The proposed system, helps to recognise gestures used in American Sign Language for the people unknown to it. This system provides an opportunity for deaf and those hard of hearing to communicate with normal people not knowing the sign language, as help of interpreters is not possible for everyone and everywhere. Many country's has own sign language, such as ASL, ISL, etc. This paper presents the use of MATLAB for implementation of the system. Here, the sign is done using image input . Pre-processing on the image is done and features are extracted . Comparison of the features is done with features located in database . This system helps to bridge the barrier between the physically challenged persons and the normal.

Chepter one

INTRODUCTION

1.1 INTRODUCTION TO MATLAB

MATLAB is widely used in all areas of applied mathematics, in education and research at universities, and in the industry. MATLAB stands for Matrix Laboratory and the software is built up around vectors and matrices. This makes the software particularly useful for linear algebra but MATLAB is also a great tool for solving algebraic and differential equations and for numerical integration. MATLAB has powerful graphic tools and can produce nice pictures in both 2D and 3D. It is also a programming language, and is one of the easiest programming languages for writing mathematical programs. MATLAB also has some tool boxes useful for signal processing, image processing, optimization, etc.[1]

1.2 Useful functions and operations in MATLAB

Using MATLAB as a calculator is easy.

Example: Compute $5\sin(2.5^{3-pi})+1/75$. In MATLAB this is done by simply typing

5*sin(2.5^(3-pi))+1/75

at the prompt. Be careful with parentheses and don't forget to type * whenever you multiply!

Note that MATLAB is *case sensitive*. This means that MATLAB knows a difference between letters written as lower and upper case letters. [1]

1.3 Digital Image Processing

An image may be defined as a two-dimensional function, where *x* and *y* are *spatial* (plane) coordinates, and the amplitude of *f* at any pair of coordinates (*x*, *y*) is called the *intensity* or *gray level* of the image at that point. When *x*, *y*, and the intensity values of *f* are all finite, discrete quantities, we call the image a *digital image*. The field of *digital image processing* refers to processing digital images by means of a digital computer. There is no general agreement among authors regarding where image processing stops and other related areas, such as image analysis and computer vision, start. Sometimes a distinction is made by defining image processing as a discipline in which both the input and output of a process are images.

image processing operation. On the other hand, there are fields such as computer vision whose ultimate goal is to use computers to emulate human vision, including learning and being able to make inferences and take actions based on visual inputs. This area itself is a branch of artificial intelligence (AI) whose objective is to emulate human intelligence. The area of image analysis (also called image understanding) is in between image processing and computer vision. There are no clear-cut boundaries in the continuum from image processing at one end to computer vision at the other. However, one useful paradigm is to consider three types of computerized processes in this continuum: low-, mid-, and high-level processes.[2]

➢ Low-level processes involve primitive operations such as image preprocessing to reduce noise, contrast enhancement, and image sharpening.

➢ Mid-level processing on images involves tasks such as segmentation (partitioning an image into regions or objects), description of those objects to reduce them to a form suitable for

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computer processing, and classification (recognition) of individual objects

➢ Finally, higher-level processing involves "making sense" of an ensemble of recognized objects, as in image analysis, and, at the far end of the continuum, performing the cognitive functions normally associated with vision. Based on the preceding comments, we see that a logical place of overlap between image processing and image analysis is the area of recognition of individual regions or objects in an image. [2]

1.4 Components of an Image Processing System

the mid-1980s, numerous models of image processing systems being sold throughout the world were rather substantial peripheral devices that attached to equally substantial host computers. Late in the 1980s and early in the 1990s, the market shifted to image processing hardware in the form of single boards designed to be compatible with industry standard buses and to fit into engineering workstation cabinets and personal computers. In addition to lowering costs, this market shift also served as a catalyst for a significant number of new companies specializing in the development of software written specifically for image processing. Although large-scale image processing systems still are being sold for massive imaging applications, such as processing of satellite images, the trend continues toward miniaturizing and blending of general-purpose small computers with specialized image processing hardware. There are two elements are required to acquire digital images. The first is a physical device that is sensitive to the energy radiated by the object we wish to image. The second, called a *digitizer*, is a device for converting the output of the physical sensing device into digital form. For instance, in a digital video camera, the sensors produce an electrical output proportional to light intensity.[2]

1.4.1 Pre-processors : Preprocessors that include image size a change and image enhancement

🔸 **image size :** The process of resizing the image is identical to the image in the database where it enlarges or reduces the image and according to the appropriate size.
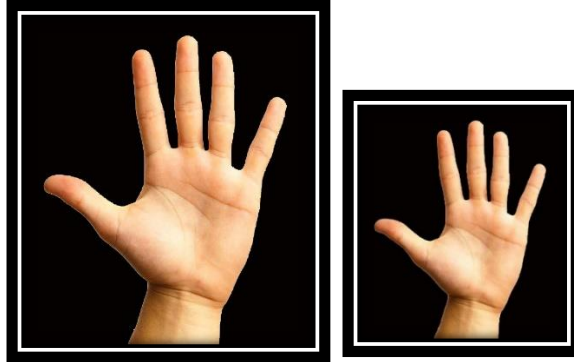

Figure 1: Resize the image

🔸 **Enhancing images :** Image enhancement processes consist of a collection of techniques that seek to improve the visual appearance of an image or to convert the image to a form better suited for analysis by a human or a machine. In an image enhancement system, there is no conscious effort to improve the fidelity of a reproduced image with regard to some ideal form of the image, as is done in image restoration. Actually, there is some evidence to indicate that often a distorted image, for example, an image with amplitude overshoot and undershoot about its object edges, is more subjectively pleasing than a perfectly reproduced original.[3]

Figure 2: Enhancing image

1.4.2 Feature Extraction: is a dimensionality reduction process, where an initial set of raw variables is reduced to more manageable groups (features) for processing, while still accurately and completely describing the original data set. When the input data to an algorithm is too large to be processed and it is suspected to be redundant (e.g. the same measurement in both feet and meters, or the repetitiveness of images presented as pixels), then it can be transformed into a reduced set of features (also named a feature vector). Determining a subset of the initial features is called feature selection[3]. Where they include:

1. Energy
2. Moment
3. Central moment
4. Standard division
5. Mean
6. Skew

And will talk is short for moment and central moment

Moment : In image processing, computer vision and related fields, an image moment is a certain particular weighted average (moment) of the image pixels' intensities, or a function of such moments, usually chosen to have some attractive property or interpretation. Image moments are useful to describe objects after segmentation. Simple properties of the image which are found *via* image moments include area (or total intensity), its centroid, and information about its orientation.For a 2D continuous function *f(x,y)* the moment (sometimes called "raw moment") of order (*p* + *q*) is defined as

$$M_{pq} = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} x^p y^q \, f(x,y) \, dx \, dy \qquad \ldots\ldots\ldots(1)$$

for p,q = 0,1,2,... Adapting this to scalar (greyscale) image with pixel intensities $I(x,y)$, raw image moments M_{ij} are calculated by[3]

$$M_{ij} = \sum_x \sum_y x^i y^j I(x,y) \quad \text{.................(2)}$$

In some cases, this may be calculated by considering the image as a <u>probability density function</u>, *i.e.*, by dividing the above by[3]

$$\sum_x \sum_y I(x,y) \quad \text{...............(3)}$$

Central moments

Central moments are defined as

$$\mu_{pq} = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} (x - \bar{x})^p (y - \bar{y})^q f(x,y)\, dx\, dy \quad \text{.............(4)}$$

where $\bar{x} = \dfrac{M_{10}}{M_{00}}$ and $\bar{y} = \dfrac{M_{01}}{M_{00}}$ are the components of the centroid.

If $f(x, y)$ is a digital image, then the previous equation becomes[3]

$$\mu_{pq} = \sum_x \sum_y (x - \bar{x})^p (y - \bar{y})^q f(x,y) \quad \text{...........(5)}$$

1.4.3 Edge detection: includes a variety of mathematical methods that aim at identifying points in a digital image at which the image brightness changes sharply or, more formally, has discontinuities. The points at which image brightness changes sharply are typically organized into a set of curved line segments termed *edges*. Edge detection is a fundamental tool in image processing, machine vision and computer vision, particularly in the areas of feature detection and feature extraction.[4] where include

1. Sobel
2. Prewitt
3. Robert
4. Laplacian
5. Robinson
6. Kirsch
7. Canny

And will talk is short for canny

🔸 **Canny:** Although his work was done in the early days of computer vision, the Canny edge detector (including its variations) is still a state-of-the-art edge detector. Edge detectors that perform better than the Canny usually require longer computation times or a greater number of parameters.

1.5 Digital Image Processing Using MATLAB

the power that MATLAB brings to digital image processing is an extensive set of functions for processing multidimensional arrays of which images (two-dimensional numerical arrays) are a special case. The Image Processing Toolbox is a collection of functions that extend the capability of the MATLAB numeric computing environment. These

functions, and the expressiveness of the MATLAB language, make image-processing operations easy to write in a compact, clear manner, thus providing an ideal software prototyping environment for the solution of image processing problems. [5]

1.6 some function using in matlab to image processing

function	Using function	Example
imread('filename')	Read image	>> f = imread('chestxray.jpg');
[D1, D2,..., DK] = size(A)	size	>> [M, N] = size(f);
imshow()	Display image	imshow(f)
Im2bw	Convert image to binary image	F=im2bw(x)
Rgb2ind	Convert RGB image to indexed image	[x,map]=rgb2ind(RGB,n)
imrotate	Rotate image	B=imrotate(A,angle)
edge	Find edges in grayscale image	BW=edge(I)
Imwrite	Write image to graphic file	Imwrit (x,map, 'your _hdf_file.hdf',...........)
Im2frame	Covert image to move frame	F=im2frame(x)
imhandles	Get all image handles	

Table 1 : Some image processing functions used in Matlab

Example 1

>> size(f)

ans =

      1024 1024

Example 2

>> [IND,map]= rgb2ind(RGB,32);

Figure('Name','Indexed image with 32 colors')

Images(IND)

Colormap(map)

Axis image

Zoom(4)

1.7 Image Types[5]

The toolbox supports four types of images:

• Gray-scale images

• Binary images

• Indexed images

• RGB images

Chepter Two

Sign language

2.1 sign language

Sign languages (also known as signed languages) are languages that use the visual-manual modality to convey meaning. Language is expressed via the manual sign stream in combination with non-manual elements. Sign languages are full-fledged natural languages with their own grammar and lexicon. Wherever communities of deaf people exist, sign languages have developed as handy 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. [6]

2.2 History

Groups of deaf people have used sign languages throughout history. One of the earliest written records of a sign language is from the fifth century BC, in Plato's *Cratylus,* where Socratessays: "If we hadn't a voice or a tongue, and wanted to express things to one another, wouldn't we try to make signs by moving our hands, head, and the rest of our body, just as dumb people do at present?"[7]

Until the 19th century, most of what is known about historical sign languages is limited to the manual alphabets (fingerspelling systems) that were invented to facilitate transfer of words from a spoken language to a sign language, rather than documentation of the language

itself. Pedro Ponce de León (1520–1584) is said to have developed the first manual alphabet.[8]

Figure 3 : Some of the hand signals

2.3 Importance of Sign Language for Deaf and Mute:

➢ It works to communicate between the deaf, the mute and the people and convey the mutual feelings among them.
➢ Helps to express the different needs of the deaf and dumb.
➢ It works on the mental, oral and cognitive development of the deaf and dumb.
➢ Helps to reduce the internal and psychological stress of those who suffer from speechlessness and hearing.
➢ Helps to get rid of fear, depression and depression in the deaf and dumb.
➢ It develops the social, cognitive and cultural relations of individuals.

2.4 Machine translation of sign languages

The **machine translation of sign languages** has been possible, albeit in a limited fashion, since 1977. When a research project successfully matched English letters from a keyboard to ASL manual alphabet letters which were simulated on a robotic hand. These technologies translate signed languages into written or spoken language, and written or spoken language to sign language, without the use of a human interpreter. Sign languages possess different phonological features than spoken languages, which has created obstacles for developers. Developers use computer vision and machine learning to recognize specific phonological parameters unique to sign languages, and speech recognition and natural language processing allow interactive communication between hearing and deaf people. The history of automatic sign language translation started with the development of hardware such as finger-spelling robotic hands. In 1977, a finger-spelling hand project called RALPH (short for "Robotic Alphabet") created a robotic hand that can translate alphabets into finger-spellings. [9]

2.5 Technologies translation of sign languages

❖ VISICAST
❖ eSIGN project
❖ The American Sign Language Avatar Project at DePaul University
❖ Spanish to LSE
❖ Sign Aloud
❖ Pro Deaf [10]
❖ Kinect Sign Language Translator [11]
❖ Sign All [12]
❖ Motion Savvy [13]

2.6 Some types of sign languages

- **British Sign Language(BSL)**
- **Japanese Sign Language (JSL)**
- **French Sign Language (LSF)**
- **Dutch Sign Language (NGT)**
- **Indian Sign Language (ISL)**
- **German Sign Language (DGS)**
- **American Sign Language(ASL)**

And will talk is short for American Sign Language(ASL)

American Sign Language(ASL)

American Sign Language (ASL) has become a very popular language in high schools, colleges, and universities throughout the U.S., due, in part, to the growing number of schools that allow students to take the language in order to fulfill a foreign or general language requirement. Within the past couple decades, the number of students enrolled in ASL classes has increased dramatically, and there are likely more instructors of ASL at the present time than ever before. ASL and spoken language instruction are similar in some aspects; however, there are also differences between the two (e.g., modality differences involving visual rather than auditory perception and processing, no commonly used writing system in ASL, and the socio-cultural history of deaf-hearing relations). In spite of these differences, minimal research has been done on ASL learning and classroom pedagogy—especially in recent years. This article reports on studies that have been performed recently and it

also suggests various themes for future research. In particular, three main areas of research are proposed: the possible role of the socio-political history of the Deaf community in which ASL teaching is situated, linguistic differences between signed and spoken languages, and the use of video and computer-based technologies.[14]
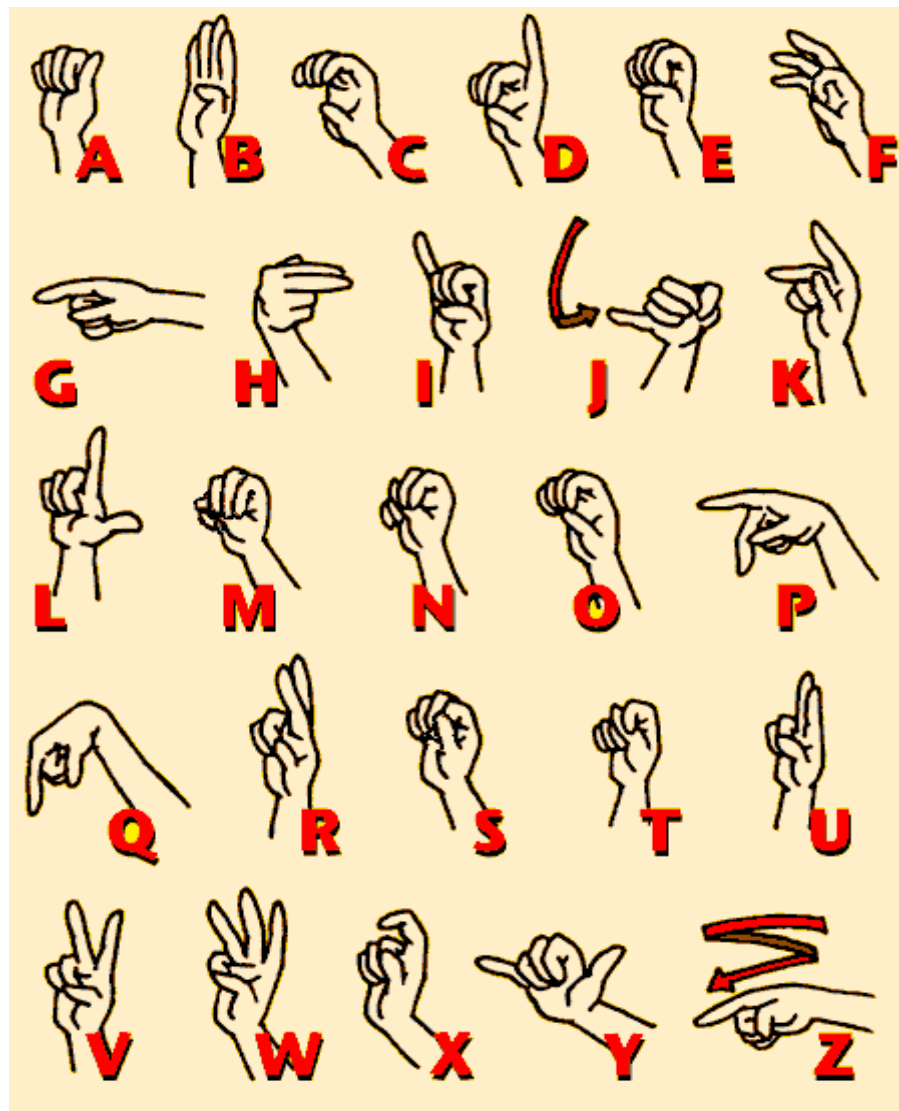

Figure 4: English letters in ASL

2.7 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.[15] 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. [14]

- 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.

- ASL-phabet is a system designed primarily for education of deaf children by Dr. Sam Supalla which uses a minimalist collection of symbols in the order of Handshape-Location-Movement. Many signs can be written the same way (homograph).

Chepter Three

Practical & suggestions

3-1 flowchart :
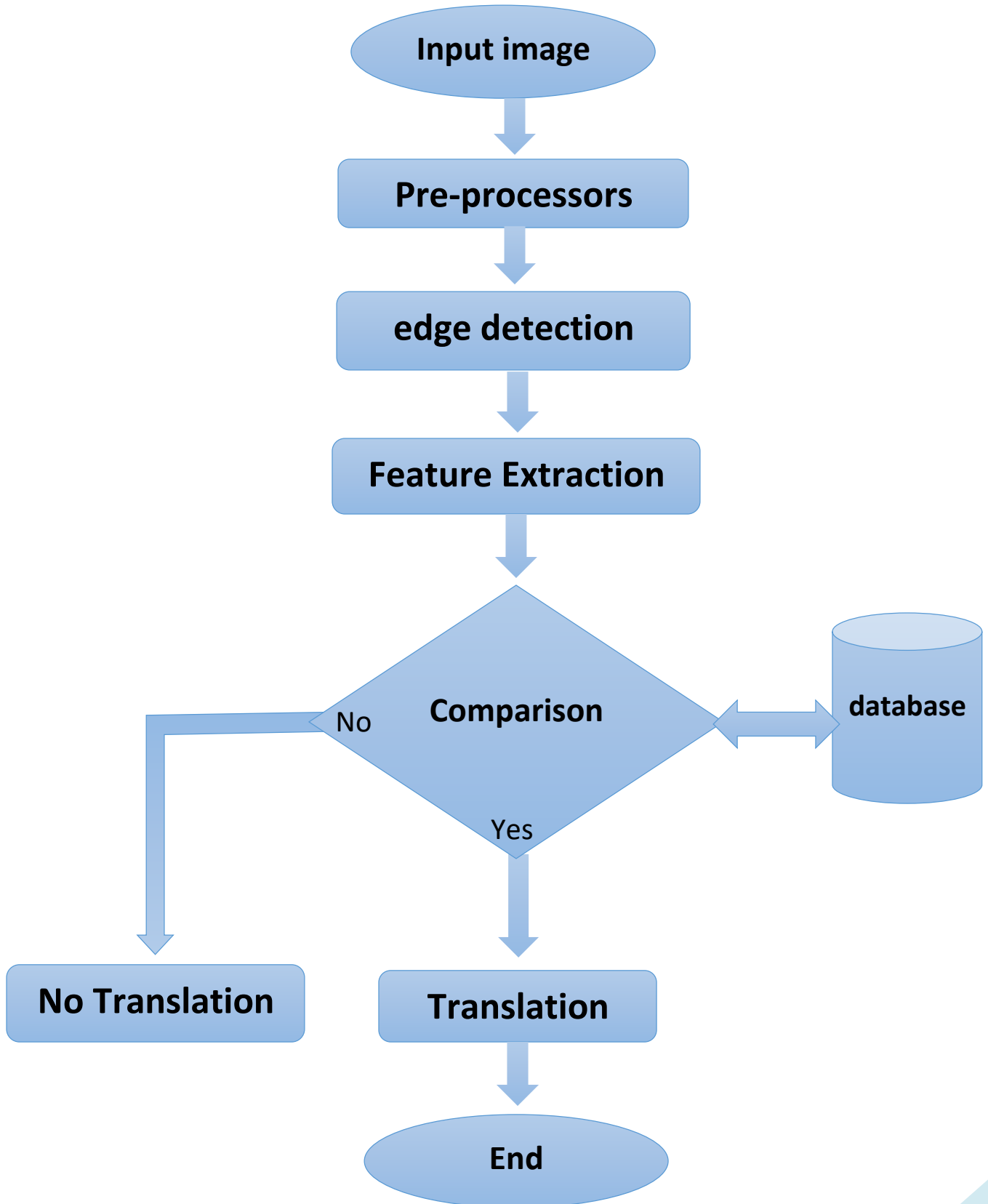
step 1 input image : In this step an image is inserted by the user from his / her own device

input image

Choose image

Insert image

Figure (6): input image to program

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step 2 Pre-processors： Preprocessors that include resize image and image enhancement

a. Resize Image
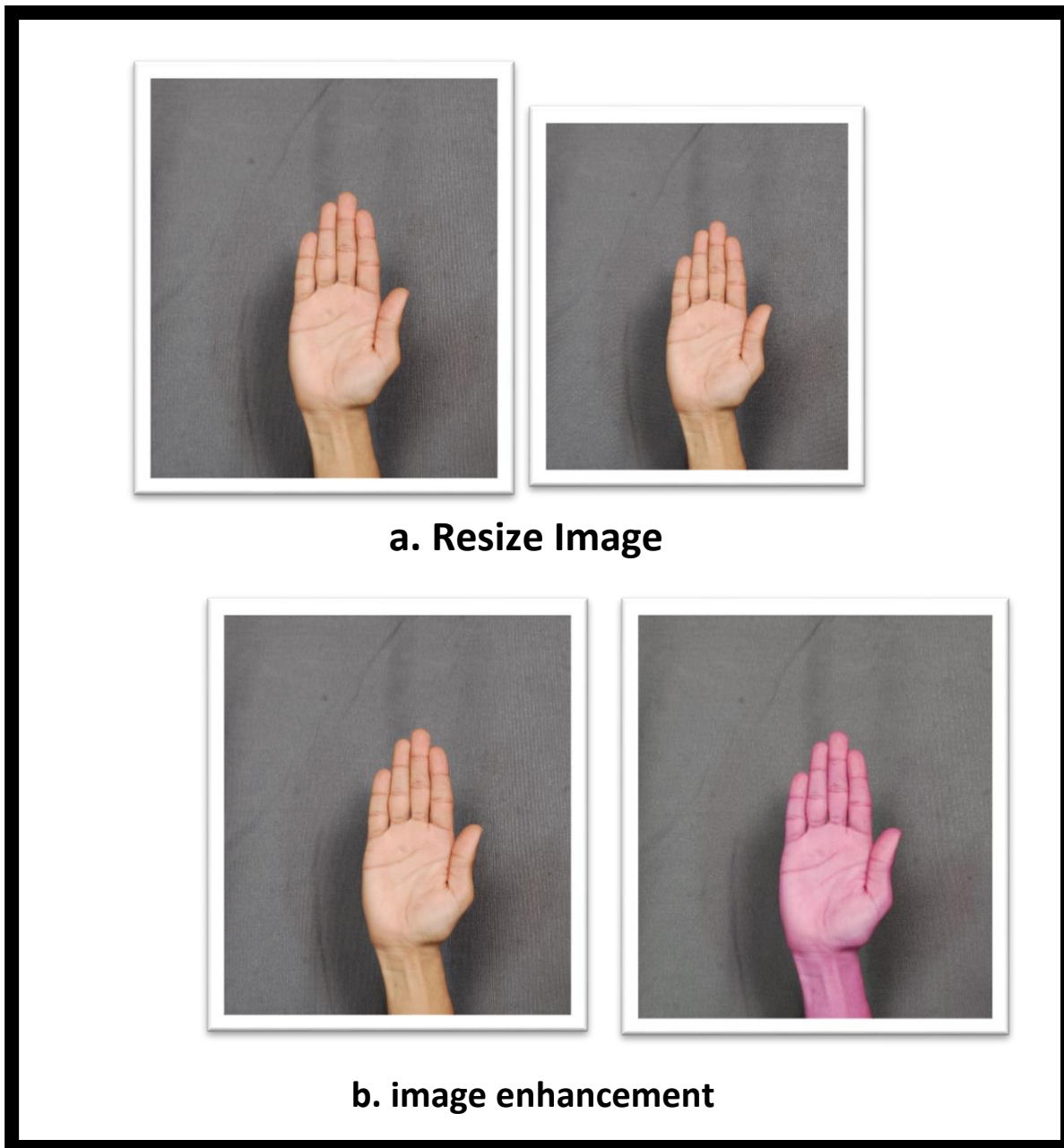
b. image enhancement

Figure (7): Pre-processors on image a. image size
b. image enhancement

Step 3 Feature Extraction: includes ; moment and central moment

step 4 edge detection: After you process , improve the image and feature extraction , we'll set the edges of the image using **The Canny edge detector**
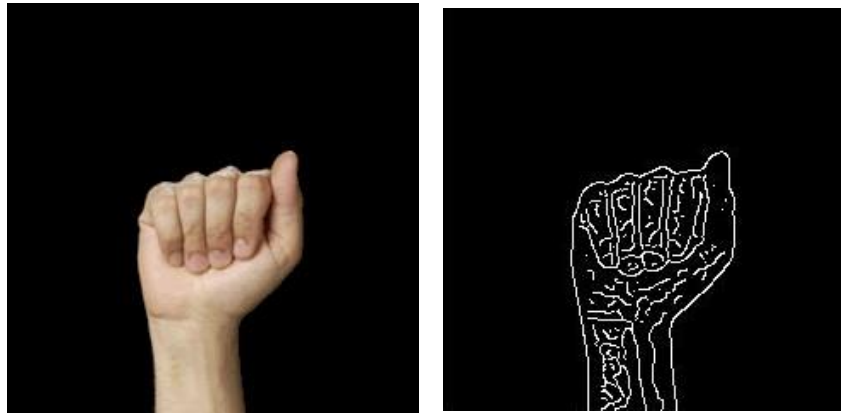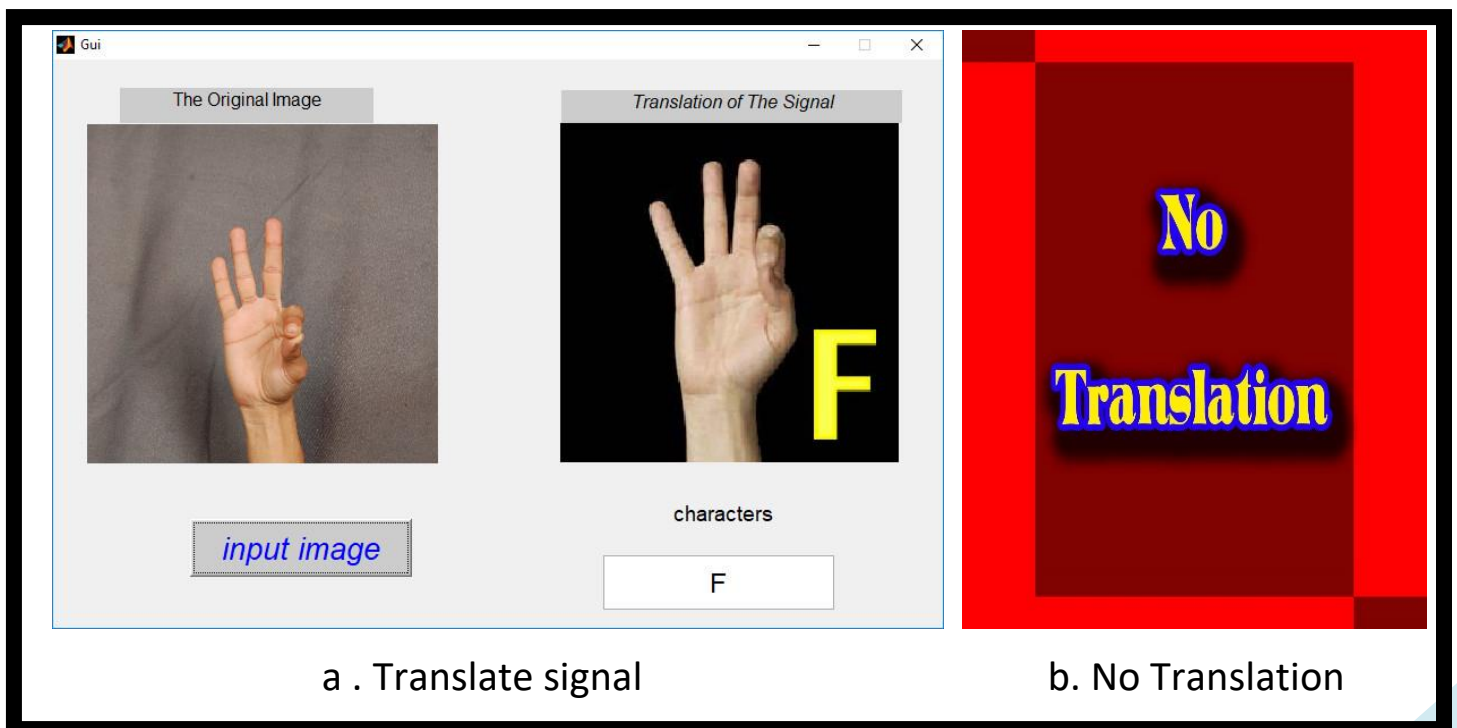

Figure (8): The Canny edge detector

Step 5 Comparison : The program compares the image entered by the user with the image that is alread stored in the database.

Step 6 Translate signal : After the comparison, the program translates the signal if the image matches the appropriate image in the database, or if it does not match, the phrase "**No Translation**"

a . Translate signal   b. No Translation

Figure (9): Translate signal a . Translate signal   b. No Translation

3-2 Suggestions

🔶 **Camera :** The camera looks like you are taking a photograph with a camera. Bend your thumb and index finger on both hands to make the four corners of the camera. Then click the camera by extending and bending the index finger on the dominant hand.

🔶 **Video :** The sign for "video" depends on what you mean. If you mean to mean the noun video as in a movie clip then you would use the sign for "MOVIE." If you mean the verb as in "to create a video" then you should use the sign "VIDEO-record."

🔶 **Sound :** Sometimes deaf people do use a spoken language, especially when talking with hearing people. Sometimes hearing people use a sign language with each other, rather than speaking. But, deaf people tend to use sign languages, and hearing people tend to use spoken languages. Some deaf people can also understand spoken words by looking at a speaker's lips. This is known as lip-reading. It is hard to learn, and few people do it well. Sometimes signing and lip-reading are combined, especially when deaf and hearing people are talking to each other.

🔶 **Online :** Signing Online provides interactive web-based instruction in American Sign Language (ASL). It allows you to learn ASL at your own pace, anywhere, anytime.

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