

**ABSTRACT**

*Sign language is the only tool of communication for the person who is not able to speak and hear anything. Sign language is a boon for the physically challenged people to express their thoughts and emotion. In this work, a novel scheme of sign language recognition has been proposed for identifying the alphabets and gestures in sign language. With the help of computer vision and neural networks we can detect the signs and give the respective text output.*

***Key Word :*** *Sign LanguageRecognition1, Convolution Neural Network2, Image Processing3, Edge Detection4, Hand Gesture Recogniton5.*

**INTRODUCTION**

Speech impaired people use hand signs and gestures to communicate. Normal people face difficulty in understanding their language. Hence there is a need of a system which recognizes the different signs, gestures and conveys the information to the normal people. It bridges the gap between physically challenged people and normal people.

**IMAGE PROCESSING:**

Image processing is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. It is a type of signal processing in which input is an image and output may be image or characteristics/features associated with that image. Nowadays, image processing is among rapidly growing technologies. It forms core research area within engineering and computer science disciplines too.

Image processing basically includes the following three steps:

• Importing the image via image acquisition tools.

• Analysing and manipulating the image.

• Output in which result can be altered image or report that is based on image analysis.

There are two types of methods used for image processing namely, analogue and digital image processing. Analogue image processing can be used for the hard copies like printouts and photographs. Image analysts use various fundamentals of interpretation while using these visual techniques. Digital image processing techniques help in manipulation of the digital images by using computers. The three general phases that all types of data have to undergo while using digital technique are pre- processing, enhancement, and display, information extraction.

**Digital image processing:**

Digital image processing consists of the manipulation of images using digital computers. Its use has been increasing exponentially in the last decades. Its applications range from medicine to entertainment, passing by geological processing and remote sensing. Multimedia systems, one of the pillars of the modern information society, rely heavily on digital image processing.

Digital image processing consists of the manipulation of those finite precision numbers. The processing of digital images can be divided into several classes: image enhancement, image restoration, image analysis, and image compression. In image enhancement, an image is manipulated, mostly by heuristic techniques, so that a human viewer can extract useful information from it.

Digital image processing is to process images by computer. Digital image processing can be defined as subjecting a numerical representation of an object to a series of operations in order to obtain a desired result. Digital image processing consists of the conversion of a physical image into a corresponding digital image and the extraction of significant information from the digital image by applying various algorithms. physical image into a corresponding digital image and the extraction of significant information from the digital image by applying various algorithms.

**Pattern recognition:** On the basis of image processing, it is necessary to separate objects from images by pattern recognition technology, then to identify and classify these objects through technologies provided by statistical decision theory. Under the conditions that an image includes several objects, the pattern recognition consists of three phases, as shown in Fig.

**

Fig1.1: Phases of pattern recognition

The first phase includes the image segmentation and object separation. In this phase, different objects are detected and separate from other background. The second phase is the feature extraction. In this phase, objects are measured. The measuring feature is to quantitatively estimate some important features of objects, and a group of the features are combined to make up a feature vector during feature extraction. The third phase is classification. In this phase, the output is just a decision to determine which category every object belongs to. Therefore, for pattern recognition, what input are images and what output are object types and structural analysis of images. The structural analysis is a description of images in order to correctly understand and judge for the important information of images.

**SIGN LANGUAGE**

It is a language that includes gestures made with the hands and other body parts, including facial expressions and postures of the body. It used primarily by people who are deaf and dumb. There are many different sign languages as, British, Indian and American sign languages. British sign language (BSL) is not easily intelligible to users of American sign Language (ASL) and vice versa .

A functioning signing recognition system could provide a chance for the inattentive communicate with non-signing people without the necessity for an interpreter. It might be wont to generate speech or text making the deaf more independent. Unfortunately there has not been any system with these capabilities thus far. during this project our aim is to develop a system which may classify signing accurately.

American Sign Language (ASL) is a complete, natural language that has the same linguistic properties as spoken languages, with grammar that differs from English. ASL is expressed by movements of the hands and face. It is the primary language of many North Americans who are deaf and hard of hearing, and is used by many hearing people as well.

**SIGN LANGUAGE AND HAND GESTURE RECOGNITION**

The process of converting the signs and gestures shown by the user into text is called sign language recognition. It bridges the communication gap between people who cannot speak and the general public. Image processing algorithms along with neural networks is used to map the gesture to appropriate text in the training data and hence raw images/videos are converted into respective text that can be read and understood.

Dumb people are usually deprived of normal communication with other people in the society. It has been observed that they find it really difficult at times to interact with normal people with their gestures, as only a very few of those are recognized by most people. Since people with hearing impairment or deaf people cannot talk like normal people so they have to depend on some sort of visual communication in most of the time. Sign Language is the primary means of communication in the deaf and dumb community. As like any other language it has also got grammar and vocabulary but uses visual modality for exchanging information. The problem arises when dumb or deaf people try to express themselves to other people with the help of these sign language grammars. This is because normal people are usually unaware of these grammars. As a result it has been seen that communication of a dumb person are only limited within his/her family or the deaf community. The importance of sign language is emphasized by the growing public approval and funds for international project. At this age of Technology the demand for a computer based system is highly demanding for the dumb community. However, researchers have been attacking the problem for quite some time now and the results are showing some promise. Interesting technologies are being developed for speech recognition but no real commercial product for sign recognition is actually there in the current market. The idea is to make computers to understand human language and develop a user friendly human computer interfaces (HCI). Making a computer understand speech, facial expressions and human gestures are some steps towards it. Gestures are the non-verbally exchanged information. A person can perform innumerable gestures at a time. Since human gestures are perceived through vision, it is a subject of great interest for computer vision researchers. The project aims to determine human gestures by creating an HCI. Coding of these gestures into machine language demands a complex programming algorithm. In our project we are focusing on Image Processing and Template matching for better output generation.

**MOTIVATION**

The 2011 Indian census cites roughly 1.3 million people with “hearingimpairment”. In contrast to that numbers from India’s National Association of the Deaf estimates that 18 million people –roughly 1 per cent of Indian population are deaf. These statistics formed the motivation for our project. As these speech impairment and deaf people need a proper channel to communicate with normal people there is a need for a system . Not all normal people can understand sign language of impaired people. Our project hence is aimed at converting the sign language gestures into text that is readable for normal people.

**PROBLEM STATEMENT**

Speech impaired people use hand signs and gestures to communicate.

Normal people face difficulty in understanding their language. Hence there is a need of a system which recognizes the different signs, gestures and conveys the information to the normal people. It bridges the gap between physically challenged people and normal people.

**ORGANISATION OF THESIS**

The book is organised as follows:

Part 1:The various technologies that are studied are introduced and the problem statement is stated alongwith the motivation to our project.

Part 2:The Literature survey is put forth which explains the various other works and their technologies that are used for Sign Language Recognition.

Part 3:Explains the methodologies in detail, represents the architecture and algorithms used.

Part 4:Represents the project in various designs.

Part 5:Provides the experimental analysis, the code involved and the results obtained.

Part 6:Concludes the project and provides the scope to which the project can be extended.

**LITERATURE SURVEY**

**INTRODUCTION:**

The domain analysis that we have done for the project mainly involved understanding the neural networks.

-captioning software, suchas DeepDream.

**Opencv**:

OpenCV (Open Source Computer Vision Library) is a library of programming functions mainly aimed at real-time computer vision.[1] Originally developed by Intel, it was later supported by Willow Garage then Itseez (which was later acquired by Intel[2]). The library is cross-platform and free for use under the open-source BSD license.

OpenCV's application areas include:

 2D and 3D feature toolkits

 Egomotion estimation

 Facial recognition system

 Gesture recognition

 Augmented reality

To support some of the above areas, OpenCV includes a statistical machine learning library that contains:

 Boosting

 Decision tree learning

 Gradient boosting trees

 Expectation-maximization algorithm

 k-nearest neighbor algorithm

 Naive Bayes classifier

 Artificial neural networks

 Random forest

 Support vector machine (SVM)

 Deep neural networks (DNN)

AForge.NET, a computer vision library for the Common Language Runtime (.NET Framework and Mono).

ROS (Robot Operating System). OpenCV is used as the primary vision package in ROS.

VXL, an alternative library written in C++.

Integrating Vision Toolkit (IVT), a fast and easy-to-use C++ library with an optional interface to OpenCV.

CVIPtools, a complete GUI-based computer-vision and image-processing software environment, with C function libraries, a COM-based DLL, along with two utility programs for algorithm development and batch processing.

OpenNN, an open-source neural networks library written in C++. List of free and open source software packages

 OpenCV Functionality

 Image/video I/O, processing, display (core, imgproc, highgui)

 Object/feature detection (objdetect, features2d, nonfree)

 Geometry-based monocular or stereo computer vision (calib3d, stitching, videostab)

 Computational photography (photo, video, superres)

 Machine learning & clustering (ml, flann)

 CUDA acceleration (gpu) Image-Processing:

Image processing is a method to perform some operations on an image, in order to get an enhanced image and or to extract some useful information from it.

If we talk about the basic definition of image processing then “Image processing is the analysis and manipulation of a digitized image, especially in order to improve its quality”.

Digital-Image :

An image may be defined as a two-dimensional function f(x, y), where x and y are spatial(plane) coordinates, and the amplitude of fat any pair of coordinates (x, y) is called the intensity or grey level of the image at that point.

In another word An image is nothing more than a two-dimensional matrix (3-D in case of coloured images) which is defined by the mathematical function f(x, y) at any point is giving the pixel value at that point of an image, the pixel value describes how bright that pixel is, and what colour it should be.

Image processing is basically signal processing in which input is an image and output is image or characteristics according to requirement associated with that image.

Image processing basically includes the following three steps : Importing the image

Analysing and manipulating the image

Output in which result can be altered image or report that is based on image analysis Applications of Computer Vision:

Here we have listed down some of major domains where Computer Vision is heavily used.

 Robotics Application

 Localization − Determine robot location automatically

 Navigation

 Vision-guided robotics surgery

 Industrial Automation Application

 Safety, e.g., driver vigilance monitoring

**Keras**:

Keras is an open-source neural-network library written in Python. It is capable of running on top of TensorFlow, Microsoft Cognitive Toolkit, R, Theano, or PlaidML. Designed to enable fast experimentation with deep neural networks, it focuses on being user-friendly, modular, and extensible. It was developed as part of the research effort of project ONEIROS (Open-ended Neuro-Electronic Intelligent Robot Operating System), and its primary author and maintainer is François Chollet, a Google engineer. Chollet also is the author of the XCeption deep neural network model.

Features: Keras contains numerous implementations of commonly used neural- network building blocks such as layers, objectives, activation functions, optimizers, anda host of tools to make working with image and text data easier to simplify the coding necessary for writing deep neural network code. The code is hosted on GitHub, and community support forums include the GitHub issues page, and a Slack channel.

In addition to standard neural networks, Keras has support for convolutional and recurrent neural networks. It supports other common utility layers like dropout, batch normalization, and pooling.

Keras allows users to productize deep models on smartphones (iOS and Android), on the web, or on the Java Virtual Machine. It also allows use of distributed training of deep-learning models on clusters of Graphics processing units (GPU) and tensor processing units (TPU) principally in conjunction with CUDA.

Pre-trained models

Trained model consists of two parts model Architecture and model Weights. Model weights are large file so we have to download and extract the feature from ImageNet database. Some of the popular pre-trained models are listed below,

 ResNet

 VGG16

 MobileNet

 InceptionResNetV2

 InceptionV3

**Numpy**:

NumPy (pronounced /ˈnʌmpaɪ/ (NUM-py) or sometimes /ˈnʌmpi/ (NUM-pee)) is a library for the Python programming language, adding support for large, multi- dimensional arrays and matrices, along with a large collection of high-level mathematical functions to operate on these arrays. The ancestor of NumPy, Numeric, was originally created by Jim Hugunin with contributions from several other developers. In 2005, Travis Oliphant created NumPy by incorporating features of the competing Numarray into Numeric, with extensive modifications. NumPy is open- source software and has many contributors.

Features: NumPy targets the CPython reference implementation of Python, which is a non-optimizing bytecode interpreter. Mathematical algorithms written for this version of Python often run much slower than compiled equivalents. NumPy addresses the slowness problem partly by providing multidimensional arrays and functions and operators that operate efficiently on arrays, requiring rewriting some code, mostly inner loops using NumPy.

Using NumPy in Python gives functionality comparable to MATLAB since they are both interpreted,and they both allow the user to write fast programs as long as most operations work on arrays or matrices instead of scalars. In comparison, MATLAB boasts a large number of additional toolboxes, notably Simulink, whereas NumPy is intrinsically integrated with Python, a more modern and complete programming language. Moreover, complementary Python packages are available; SciPy is a library that adds more MATLAB-like functionality and Matplotlib is aplotting package that providesMATLAB-like plotting functionality. Internally, both MATLAB and NumPy rely on BLAS and LAPACK for efficient linear algebra computations.

Python bindings of the widely used computer vision library OpenCV utilize NumPy arrays to store and operate on data. Since images with multiple channels are simply represented as three-dimensional arrays, indexing, slicing or masking with other arrays are very efficient ways to access specific pixels of an image. The NumPy array as universal data structure in OpenCV for images, extracted feature points, filter kernels and many more vastly simplifies the programming workflow and debugging.

Limitations: Inserting or appending entries to an array is not as trivially possible as it is with Python's lists. The np.pad(...) routine to extend arrays actually creates new arrays of the desired shape and padding values, copies the given array into the new one and returns it. NumPy'snp.concatenate([a1,a2]) operation does not actually link the two arrays but returns a new one, filled with the entries from both given arrays in sequence. Reshaping the dimensionality of an array with np.reshape(...) is only possible as long as the number of elements in the array does not change. These circumstances originate from the fact that NumPy's arrays must be views on contiguous memory buffers. A replacement package called Blaze attempts to overcome this limitation.

Algorithms that are not expressible as a vectorized operation will typically run slowly because they must be implemented in "pure Python", while vectorization may increase memory complexity of some operations from constant to linear, because temporary arrays must be created that are as large as the inputs. Runtime compilation of numerical code has been implemented by several groups to avoid these problems; open source solutions that interoperate with NumPy include scipy.weave, numexpr and Numba. Cython and Pythran are static-compiling alternatives to these.

**Neural Networks:**

A neural network is a series of algorithms that endeavors to recognize underlying relationships in a set of data through a process that mimics the way the human brain operates. In this sense, neural networks refer to systems of neurons, either organic or artificial in nature. Neural networks can adapt to changing input; so the network generates the best possible resultwithout needing to redesign the output criteria. The concept of neural networks, which has its roots in artificial intelligence, is swiftly gaining popularity in the development of trading systems.

A neural network works similarly to the human brain’s neural network. A “neuron” in a neural network is a mathematical function that collects and classifies information according to a specific architecture. The network bears a strong resemblance to statistical methods such as curve fitting and regression analysis.

A neural network contains layers of interconnected nodes. Each node is a perceptron and is similar to a multiple linear regression. The perceptron feeds the signal produced by a multiple linear regression into an activation function that may be nonlinear.

In a multi-layered perceptron (MLP), perceptrons are arranged in interconnected layers. The input layer collects input patterns. The output layer has classifications or output signals to which input patterns may map. Hidden layers fine-tune the input weightings until the neural network’s margin of error is minimal. It is hypothesized that hidden layers extrapolate salient features in the input data that have predictive power regarding the outputs. This describes feature extraction, which accomplishes a utility similar to statistical techniques such as principal component analysis.

For dimensionality reduction, Principal Component Analysis PCA is used. Deep Learning:

Deep-learning networks are distinguished from the more commonplace single-hidden- layer neural networks by their depth; that is, the number of node layers through which data must pass in a multistep process of pattern recognition.

Earlier versions of neural networks such as the first perceptrons were shallow, composed of one input and one output layer, and at most one hidden layer in between. More than three layers (including input and output) qualifies as “deep” learning. So deep is not just a buzzword to make algorithms seem like they read Sartre and listen to bands you haven’t heard of yet. It is a strictly defined term that means more than one hidden layer.

In deep-learning networks, each layer of nodes trains on a distinct set of features based on the previous layer’s output. The further you advance into the neural net, the more complex the features your nodes can recognize, since they aggregate and recombine features from the previous layer.

This is known as feature hierarchy, and it is a hierarchy of increasing complexity and abstraction. It makes deep-learning networks capable of handling very large, high- dimensional data sets with billions of parameters that pass through nonlinear functions.

Above all, these neural nets are capable of discovering latent structures within unlabeled, unstructured data, which is the vast majority of data in the world. Another word for unstructured data is raw media; i.e. pictures, texts, video and audio recordings. Therefore, one of the problems deep learning solves best is in processing and clustering the world’s raw, unlabeled media, discerning similarities and anomalies in data that no human has organized in a relational database or ever put a name to.

In the process, these neural networks learn to recognize correlations between certain relevant features and optimal results – they draw connections between feature signals and what those features represent, whether it be a full reconstruction, or with labeled data.

A deep-learning network trained on labeled data can then be applied to unstructured data, giving it access to much more input than machine-learning nets.

**Convolution neural network:**

Convolutional neural networks (CNN) is a special architecture of artificial neural networks, proposed by Yann LeCun in 1988. CNN uses some features of the visual cortex. One of the most popular uses of this architecture is image classification. For example Facebook uses CNN for automatic tagging algorithms, Amazon — for generating product recommendations and Google — for search through among users’ photos.

Instead of the image, the computer sees an array of pixels. For example, if image size is 300 x 300. In this case, the size of the array will be 300x300x3. Where 300 is width, next 300 is height and 3 is RGB channel values. The computer is assigned a value from 0 to 255 to each of these numbers. Тhis value describes the intensity of the pixel at each point.

To solve this problem the computer looks for the characteristics of the baselevel. In human understanding such characteristics are for example the trunk or large ears. For the computer, these characteristics are boundaries or curvatures. And then through the groups of convolutional layers the computer constructs more abstract concepts.In more detail: the image is passed through a series of convolutional, nonlinear, pooling layers and fully connected layers, and then generates the output.

Applications of convolution neural network: Decoding Facial Recognition:

Facial recognition is broken down by a convolutional neural network into the following major components -

 Identifying every face in the picture

 Focusing on each face despite external factors, such as light, angle, pose, etc.

 Identifying unique features

Comparing all the collected data with already existing data in the database to match a face with a name.

A similar process is followed for scene labeling as well. Analyzing Documents:

Convolutional neural networks can also be used for document analysis. This is not just useful for handwriting analysis, but also has a major stake in recognizers. For a machine to be able to scan an individual's writing, and then compare that to the wide database it has, it must execute almost a million commands a minute. It is said with the use of CNNs and newer models and algorithms, the error rate has been brought down to a minimum of 0.4% at a character level, though it's complete testing is yet to be widely seen.



Fig2.1: Layers involved in CNN

**EXISTING SYSTEM**

In Literature survey we have gone through other similar works that are implemented in the domain of sign language recognition.The summaries of each of the project works are mentioned below

**A Survey of Hand Gesture Recognition Methods in Sign Language Recognition**

Sign Language Recognition (SLR) system, which is required to recognize sign languages, has been widely studied for years.The studies are based on various input sensors, gesture segmentation, extraction of features and classifcation methods.This paper aims to analyze and compare the methods employed in the SLR systems, classi cations methods that have been used, and suggests the most promising method for future research. Due to recent advancement in classifcationmethods, many of the recent proposed works mainly contribute on the classifcation methods, such as hybrid method and Deep Learning. This paper focuses on the classifcation methodsused in prior Sign Language Recognition system. Based on our review, HMM- based approaches have been explored extensively in prior research, including its modifcations.

This study is based on various input sensors, gesture segmentation, extraction of features and classification methods. This paper aims to analyze and compare the methods employed in the SLR systems, classifications methods that have been used, and suggests the most reliable method for future research. Due to recent advancement in classification methods, many of the recently proposed works mainly contribute to the classification methods, such as hybrid method and Deep Learning. Based on our review, HMM-based approaches have been explored extensively in prior research, including its modifications.Hybrid CNN-HMM and fully Deep Learning approaches have shown promising results and offer opportunities for further exploration.

**Communication between Deaf-Dumb People and Normal People**

Chat applications have become a powerful mediathat assist people to communicate in different languages witheach other. There are lots of chat applications that are useddifferent people in different languages but there are not such achat application that has facilitate to communicate with signlanguages. The developed system isbased on Sinhala Sign language. The system has included fourmain components as text messages are converted to sign messages, voice messages are converted to sign messages, signmessages are converted to text messages and sign messages areconverted to voice messages. Google voice recognition API hasused to develop speech character recognition for voice messages.The system has been trained for the speech and text patterns by usingsome text parameters and signs of Sinhala Sign language isdisplayed by emoji. Those emoji and signs that are included inthis system will bring the normal people more close to the disabled people. This is a 2 way communication system but it uses pattern of gesture recognition which is not very realiable in getting appropriate output.

**A System for Recognition of Indian Sign Language for Deaf People using Otsu’s Algorithm**

In this paper we proposed some methods,through which the recognition of the signs becomes easy forpeoples while communication. And the result of thosesymbols signs will be converted into the text. In this project,we are capturing hand gestures through webcam andconvert this image into gray scale image. The segmentationof gray scale image of a hand gesture is performed usingOtsu thresholdingalgorithm.. Total image level is dividedinto two classes one is hand and other is background. Theoptimal threshold value is determined by computing theratio between class variance and total class variance. Tofind the boundary of hand gesture in image Canny edgedetection technique is used.In Canny edge detection we used edge based segmentation and threshold based segmentation.Then Otsu’s algorithm is used because of its simple calculation and stability.This algorithm fails, when the global distribution of the target and background vary widely.

**Intelligent Sign Language Recognition Using Image Processing**

Computer recognition of sign language is an important research problem for enabling communication with hearing impaired people. This project introduces an efficient and fast algorithm for identification of the number of fingers opened in a gesture representing an alphabet of the Binary Sign Language. The system does not require the hand to be perfectly aligned to the camera. The project uses image processing system to identify, especially English alphabetic sign language used by the deaf people to communicate. The basic objective of this project is to develop a computer based intelligent system that will enable dumb people significantly to communicate with all other people using their natural hand gestures. The idea consisted of designing and building up an intelligent system using image processing, machine learning and artificial intelligence concepts to take visual inputs of sign language’s hand gestures and generate easily recognizable form of outputs. Hence the objective of this project is to develop an intelligent system which can act as a translator between the sign language and the spoken language dynamically and can make the communication between people with hearing impairment and normal people both effective and efficient. The system is we are implementing for Binary sign language but it can detect any sign language with prior image processing.

**Sign Language Interpreter using Image Processing and Machine Learning**

Speech impairment is a disability which affects one’s ability to speak and hear. Such individuals use sign language to communicate with other people. Although it is an effective form of communication, there remains a challenge for people who do not understand sign language to communicate with speech impaired people. The aim of this paper is to develop an application which will translate sign language to English in the form of text and audio, thus aiding communication with sign language. The application acquires image data using the webcam of the computer, then it is preprocessed using a combinational algorithm and recognition is done using template matching. The translation in the form of text is then converted to audio. The database used for this system includes 6000 images of English alphabets. We used 4800 images for training and 1200 images for testing. The system produces 88% accuracy.

**GESTURE RECOGNITION SYSTEM**

Communication plays a crucial part in human life. It encourages a man to pass on his sentiments, feelings and messages by talking, composing or by utilizing some other medium. Gesture based communication is the main method for Communication for the discourse and hearing weakened individuals. Communication via gestures is a dialect that utilizations outwardly transmitted motions that consolidates hand signs and development of the hands, arms, lip designs, body developments and outward appearances, rather than utilizing discourse or content, to express the individual's musings. Gestures are the expressive and important body developments that speaks to some message or data. Gestures are the requirement for hearing and discourse hindered, they pass on their message to others just with the assistance of motions. Gesture Recognition System is the capacity of the computer interface to catch, track and perceive the motions and deliver the yield in light of the caught signals. It enables the clients to interface with machines (HMI) without the any need of mechanical gadgets. There are two sorts of sign recognition methods: image- based and sensor- based strategies. Image based approach is utilized as a part of this project that manages communication via gestures motions to distinguish and track the signs and change over them into the relating discourse and content.

**PROPOSED WORK**

Our proposed system is sign language recognition system using convolution neural networks which recognizes various hand gestures by capturing video and converting it into frames. Then the hand pixels are segmented and the image it obtained and sent for comparison to the trained model. Thus our system is more robust in getting exact text labels of letters.

**System Architecture:**



Fig2.2:Architecture of Sign Language recognition System

**TRAINING MODULE:**

Supervised machine learning:It is one of the ways of machine learning where the model is trained by input data and expected output data. Тo create such model, it is necessary to go through the following phases:

1. model construction

2. model training

3. model testing

4. model evaluation

**Model construction:** It depends on machine learning algorithms. In this projectscase, it was neural networks.Such an agorithm looks like:

1. begin with its object: model = Sequential()

2. then consist of layers with their types: model.add(type\_of\_layer())

3. after adding a sufficient number of layers the model is compiled. At this moment Keras communicates with TensorFlow for construction of the model. During model compilation it is important to write a loss function and an optimizer algorithm. It looks like: model.comile(loss= ‘name\_of\_loss\_function’, optimizer= ‘name\_of\_opimazer\_alg’ ) The loss function shows the accuracy of each prediction made by the model.

Before model training it is important to scale data for their further use.

**Model training:**

After model construction it is time for model training. In this phase, the model is trained using training data and expected output for this data. It’s look this way: model.fit(training\_data, expected\_output). Progress is visible on the console when the script runs. At the end it will report the final accuracy of the model.

**Model Testing:**

During this phase a second set of data is loaded. This data set has never been seen by the model and therefore it’s true accuracy will be verified. After the model training is complete, and it is understood that the model shows the right result, it can be saved by: model.save(“name\_of\_file.h5”). Finally, the saved model can be used in the real world. The name of this phase is model evaluation. This means that the model can be used to evaluate new data.

**CONCLUSION**

Nowadays, applications need several kinds of images as sources of information for elucidation and analysis. Several features are to be extracted so as to perform various applications. When an image is transformed from one form to another such as digitizing, scanning, and communicating, storing, etc. degradation occurs. Therefore the output image has to undertake a process called image enhancement, which contains of a group of methods that seek to develop the visual presence of an image. Image enhancement is fundamentally enlightening the interpretability or awareness of information in images for human listeners and providing better input for other automatic image processing systems. Image then undergoes feature extraction using various methods to make the image more readable by the computer.Sign language recognition system is a powerful tool to preparae an expert knowledge, edge detect and the combination of inaccurate information from different sources the intend of convolution neural network is to get the appropriate classification

**REFERENCE**

Base Paper:

[1] http://cs231n.stanford.edu/reports/2016/pdfs/214\_Report.pdf

[2] http://www.iosrjen.org/Papers/vol3\_issue2%20(part-2)/H03224551.pdf

Other References:

[3]http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.734.8389&rep=rep1&typ e=pdf

[4]http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.734.8389&rep=rep1&typ e=pdf

[5] https://ieeexplore.ieee.org/document/7507939

[6] https://ieeexplore.ieee.org/document/7916786

[7] https://www.sciencedirect.com/science/article/pii/S1877050917320720

[8] https://medium.com/@RaghavPrabhu/understanding-of-convolutional-neural- network-cnn-deep-learning-99760835f148

[9][https://adeshpande3.github.io/adeshpande3.github.io/A-Beginner's-Guide-To- Understanding-Convolutional-Neural-Networks/](https://adeshpande3.github.io/adeshpande3.github.io/A-Beginner's-Guide-To-%20Understanding-Convolutional-Neural-Networks/)

