**TWO WAY SIGN LANGUAGE INTERPRETER USING DEEP LEARNING**

**A MINI PROJECT REPORT**

***Submitted by***

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**BONAFIDE CERTIFICATE**

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Place:

Date:

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**ACKNOWLEDGEMENT**

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**ABSTRACT**

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Sign language plays an important part in the hearing/speech impaired person's life as it is the prime medium of communication for them. However, not everyone understands the sign language hence, it becomes difficult for the disabled to communicate in day-to-day life. The sign language constitutes of various hand gestures which can represent various words and expressions. In this project, the aim is to build a reliable communication interpretation program for interpreting sign language and converting it to a readable output.  The task can be accomplished using image processing and deep learning.  Our proposed project can find its applicability in the day to day lives of millions of people and allow for better communication.

**INTRODUCTION**

**CHAPTER 1**

**1.1 INTRODUCTION:**

**1.2 DATA PREPROCESSING:**

Data preprocessing is a data mining technique that involves transforming raw data into an    understandable format. Real-world data is often incomplete, inconsistent, and/or lacking in certain behaviors or trends, and is likely to contain many errors. Data preprocessing is a proven method of resolving such issues. Data preprocessing prepares raw data for further processing.

Data preprocessing is used database-driven applications such as customer relationship management and rule-based applications (like neural networks). Steps involved in preprocessing are:

**1. DATA CLEANING:**

Data is cleansed through processes such as filling in missing values, smoothing the noisy data, or resolving the inconsistencies in the data.

**2. DATA INTEGRATION**

Data with different representations are put together and conflicts within the data are resolved.

**3. DATA TRANSFORMATION**

Data is normalized, aggregated and generalized.

**4. DATA REDUCTION**

This step aims to present a reduced representation of the data in a data warehouse.

**5. DATA DISCRETIZATION**

Involves reduction in number of values of a continuous attribute there by dividing the range of attribute intervals.

**1.3** **FEATURE SELECTION:**

This becomes even more important when the numbers of features are very large. Feature selection has been the focus of interest for quite some time and much work has been done. With the creation of huge databases and the consequent requirements for good machine learning techniques, new problems arise and novel approaches to feature selection   are in demand. Feature selection is the use of specific variables or data points to maximize efficiency in this type of advanced data science. It reduces the complexity of a model and makes it easier to interpret.It improves the accuracy of a model.

Major reasons to use feature selection are:

1. It enables the machine learning algorithm to train faster.

2. It reduces the complexity of a model and makes it easier to interpret.

3. It improves the accuracy of a model if the right subset is chosen.

4. It reduces over-fitting.

**1.4 MACHINE LEARNING:**

Machine learning is one element (perhaps the driving force) of AI, whereby a computer is programmed with the ability to self-teach and improve its performance of a specific task. In essence, machine learning is all about analyzing big data; the automatic extraction of information and using it to make predictions, decipher whether the prediction was correct, and if incorrect, learning from that to make a more correct prediction in the future. Machine Learning is the field of study that gives computers the capability to learn without being explicitly programmed. ML is one of the most exciting technologies that one would have ever come across. As it is evident from the name, it gives the computer that which makes it more similar to humans: The ability to learn. Machine learning is actively being used today, perhaps in many more places than one would expect.

**1.5 DEEP LEARNING:**

Deep learning can be considered as a subset of [machine learning](https://www.simplilearn.com/tutorials/machine-learning-tutorial/what-is-machine-learning). It is a field that is based on learning and improving on its own by examining computer algorithms. While machine learning uses simpler concepts, deep learning works with artificial neural networks, which are designed to imitate how humans think and learn.  Deep learning has aided image classification, language translation, speech recognition. It can be used to solve any pattern recognition problem and without human intervention. [Artificial neural networks](https://www.simplilearn.com/tutorials/deep-learning-tutorial/multilayer-perceptron), comprising many layers, drive deep learning. Deep Neural Networks (DNNs) are such types of networks where each layer can perform complex operations such as representation and abstraction that make sense of images, sound, and text. Considered the fastest-growing field in machine learning, deep learning represents a truly disruptive digital technology, and it is being used by increasingly more companies to create new business models.

**1.6 CONVOLUTIONAL NEURAL NETWORKS (CNN):**

A **Convolutional Neural Network (ConvNet/CNN)** is a Deep Learning algorithm which can take in an input image, assign importance (learnable weights and biases) to various aspects/objects in the image and be able to differentiate one from the other. The pre-processing required in a ConvNet is much lower as compared to other classification algorithms. While in primitive methods filters are hand-engineered, with enough training, ConvNets have the ability to learn these filters/characteristics.

The architecture of a ConvNet is analogous to that of the connectivity pattern of Neurons in the Human Brain and was inspired by the organization of the Visual Cortex. Individual neurons respond to stimuli only in a restricted region of the visual field known as the Receptive Field. A collection of such fields overlap to cover the entire visual area.

**LITERATURE SURVEY**

**CHAPTER 2**

**2.1 LITERATURE SURVEY**

**2.1.1** [**MODELS FOR HAND GESTURE RECOGNITION**](https://arxiv.org/pdf/2004.11706.pdf)

**Authors: Manasi Agarwal, Rutuja Ainapure, Shrushti Agarwal, Simran Bhosale, Dr. Sharmishta Desai**

This paper aims to interpret sign language hand gestures from a live stream captured by the webcam using CNN which is mostly used algorithm for visual imagery. The authors used Inception V3 for Transfer learning which is a CNN model and is 48 layers deep. Transfer learning helps to retain the knowledge that the model has learnt during its original training and allows users to define their own layers and retrain a couple of existing layers and apply it on their own smaller datasets. The authors also uses another model as a base model and parameters which gets differently tuned in each training.

**DATASET USED**: Kaggle MNIST dataset

**ALGORITHMS DEPLOYED**: Adam Optimizer, Inception V3

**SOFTWARE/ HARDWARE**: Web Camera

**LIMITATION**: The model doesn’t work well for larger datasets with more alphabets.

**2.1.2 LARGE SCALE SIGN LANGUAGE INTERPRETATION**

**Authors: Tiantian Yuan, Shagan Sah, Tejaswini Anathanarayanan, Chi Zang, Aneesh Bhat, Sahaj Gandhi, Raymond Ptucha**

This paper emphasizes on two types of sign languages- isolated and continuous sign language. Isolated sign language refers to the data at word or phrase level, which cannot be trained for unconstrained sign language recognition and translation. Continuous sign language is at the level of complete sentences or full coherent thoughts. This paper introduces largest continuous sign language dataset, and then proposes several deep learning frameworks for advanced sign language interpretation. This paper is based on the fact that sign language builds a communication system composed of hand pattern movement, facial expression, and body pose.

**DATASET USED**: Chinese Sign Language Dataset

**ALGORITHMS DEPLOYED**: Sequence-To-Sequence, Two Layers LSTM

**SOFTWARE/ HARDWARE**: Data Glove, Myoelectric sensors, Cameras, Depth sensors, RGB Sensors.

**LIMITATION**: The currently employed methods are able to overfit the training splits.

**2.1.3 DEVELOPMENT OF A SIGN LANGUAGE FOR TOTAL PARALYSIS AND INTERPRETATION USING DEEP LEARNING**

**Authors: Zahan Zib Sarowar Dhrubo, Ashiful Islam Hridoy, Lafifa Jamal, Sujan Sarker, Mohammad Shidujaman.**

This paper proposes an approach for communicating with the paralyzed patient, by capturing the movement of eyeball as a sign gesture. It emphasizes that eye-tracking is the measure of gaze. Tracking eyes with the computer system requires sensor data that represents the position of the eye. The main contributions of this paper include;

* Introduction of new sign language for people with total paralysis
* The new sign language proposed is not dependent on electronic technology as it can be interpreted anyone with assisting chart
* CNN model has been built to detect the eye pupil position and thus interpret the sign language.

**DATASET USED**: Own dataset comprising 14500 images

**ALGORITHMS DEPLOYED**: CNN

**SOFTWARE/ HARDWARE**: Web Camera

**SCOPE**: A sign language with proper grammar has been developed which can be further utilized.

**2.1.4 INDIAN SIGN LANGUAGE INTERPRETER USING IMAGE PROCESSING AND MACHINE LEARNING**

**Authors: Shubhendu Apoorv, Sudharshan Kumar Bhownick, R Sakthi Prabha**

This paper aims to eliminate the communication barrier between the differently abled people (Deaf and dumb) and the speaking community. This paper employs Image processing and Machine learning techniques and algorithms. This paper developed a simple and lightweight deep learning algorithm which can detect sign-language gestures and deploys in a Raspberry Pi. This paper, aims at building a reliable communication interpretation program for interpreting Indian sign language and converting it to a readable output. The task is accomplished using Image processing and Machine learning.

**DATASET USED**: Indian Sign Language Dataset

**ALGORITHMS DEPLOYED**: CNN, HSV

**SOFTWARE/ HARDWARE**: Web Camera

**SCOPE**: This is portable via raspberry pi.

**2.1.5 SIGN LANGUAGE INTERPRETATION USING DEEP LEARNING**

**Authors: Jessica Dias, Dishita Patil, PraptiRaut, Malvina Lopes**

This paper proposes a sign language recognition system for people who do not know sign language, to communicate easily with the hearing-impaired people. This project focuses on interpreting American Sign Language and also provides a complete overview of deep learning-based methodologies for sign language recognition.

**DATASET USED**: American Sign Language Dataset

**ALGORITHMS DEPLOYED**: CNN, HSV

**SOFTWARE/ HARDWARE**: Web Camera

**ADVANTAGE:** This project is implemented without the help of glove sensors.

**2.1.6 REAL-TIME CONVERSION OF SIGN LANGUAGE TO TEXT AND SPEECH**

**Authors: Kohsheen Tiku, Jayshree Maloo, Aishwarya Ramesh, Indra R**

This paper presents an analysis of the performance of different techniques that have been used for the conversion of sign language to text/speech format. The project is designed and implemented using Android Studio and OpenCV functions in Java. The steps involved in this process are Calibration, Processing of frame, Detection method includes Contour masking, Skeletonization, Canny Edges, further involves Kernel, Dimensionality Reduction, Classification, Post Processing. The proposed system could efficiently recognize the alphabets from images using a customized SVM model. This project is aimed at societal contribution.

**DATASET USED**: Indian Sign Language Dataset

**ALGORITHMS DEPLOYED**: American Sign Language Dataset

**SOFTWARE/ HARDWARE**: Web Camera

**SCOPE**: It shows the construction of the word ‘ILL’ and various options like ‘Add’, ‘Back’, ‘Clear’ and ‘Speech’.