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A Project Report on

Study of Deep Learning for Implementation of Sign Language Recognition

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CERTIFICATE

It is hereby certified that the work which is being presented in the Third Year Project Design Report entitled **"Study of Deep Learning for Implementation of Sign Language Recognition"**, in partial fulfillment of the requirements for the award of the Bachelor of Technology in Computer Engineering and Technology and submitted to the **School of Computer Engineering and Technology** of **MIT Academy of Engineering, Alandi(D), Pune, Affiliated to Savitribai Phule Pune University (SPPU), Pune**, is an authentic record of work carried out during Academic Year Semester **V**, under the supervision of **Dr. Sunilkumar Bhagat**, **School of Computer Engineering and Technology**

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Signature of internal examiner — *Signature of external examiner*

DECLARATION

We the undersigned solemnly declare that the project report is based on our own work carried out during the course of our study under the supervision of **Dr. Sunilkumar Bhagat**.

We assert the statements made and conclusions drawn are an outcome of our project work. We further certify that

1. The work contained in the report is original and has been done by us under the general supervision of our supervisor.
2. The work has not been submitted to any other Institution for any other degree/diploma/certificate in this Institute/University or any other Institute/University of India or abroad.
3. We have followed the guidelines provided by the Institute in writing the report.
4. Whenever we have used materials (data, theoretical analysis, and text) from other sources, we have given due credit to them in the text of the report and giving their details in the references.

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Contents

ABSTRACT

Sign language is a way of communication that is used by people with hearing or speech difficulties. Different countries have their own sign language. There are various sign languages available like American Sign Language, British Sign Language, Chinese Sign Language, and many more. Indian Sign Language abbreviated as ISL is used in India for communication. More than 27 lakh Indians have problems with hearing and speech, out of which around 97 percent use Indian Sign Language to communicate. However, the people who can interpret the language are not available and also not affordable for the same. Therefore, research is been carried out on the development of a system for Indian Sign Language Recognition. The system designing for the ISL is difficult as compared to other Sign Languages. ISL consists of one-handed as well as two-handed gestures which makes it complex to interpret. This project aims to create a web application using deep learning methodology which will help in interpreting Indian Sign Language and convert it into textual and speech format which can be accessible for helping the deaf and dumb community.

Chapter 1

Introduction

The Deaf and Dumb people use sign language as their primary way of expressing themselves to their own community as well as other people by using gestures of the hand. The language has its own meaning that is different from the language which is spoken.

The messages are conveyed using hand gestures. Globally, about 140 to 300 different sign languages are used. In India, certified people who can interpret sign language are only about 300. The limited number of sign language interpreters makes it difficult to teach sign language to deaf and dumb people. To convert sign language into text or speech, sign language systems are been developed. Deep Learning and Computer Vision have a large scope in this domain by which we can build the models for interpretation. Using deep learning and image processing algorithms we are able to classify the hand gestures and produce the appropriate result.

The most well-known neural network algorithm which is widely used in image and video processing is Convolution Neural Networks. Different models can be created and deployed in web frameworks where hand gestures are recognized by the live camera input and then converted into textual and speech formats.

1.1 Background

To help the deaf and dumb community, sign languages are developed. The information is conveyed by hand movements, hand shapes, and orientation. Indian Sign Language is the language mostly used in South Asian countries. The differentiation in Indian Sign Language as compared to other languages is it makes use of both hands.

The invention of algorithms that are artificially intelligent and the availability of big data and computing resources have led to growth in human-computer interaction. Sign Language interpretation is an application having human-computer interaction.

The aim of this project is to recognize the alphabet and digits from the Indian Sign Language. It is a complicated task to recognize hand gestures in this language, especially because of the use of both hands. Many development works are made using hand gloves sensors, and image processing techniques like edge detection but satisfactory results are not found.

In India, about 27 lakh people are deaf and dumb. So, they use hand gestures to communicate with each other and society. But, the number of people knowing these gesture in sign language are limited and require a person who can interpret for them. This project will help in decreasing the communication gap by developing software that is able to predict alphanumeric gestures in real time.

1.2 Project Idea

To design a system for recognizing Indian Sign Language hand gestures using deep learning techniques of Convolutional Neural Networks. The aim of this project is to predict the gesture of the Indian Sign Language and convert it into textual and speech format.

1.3 Motivation

One of the most basic needs to survive in society is communication. People with hearing and speech difficulties use sign language to communicate with each other but this language is not understood by normal people. The majority of work has been done on American Sign Language recognition. Indian Sign Language is significantly different from American Sign Language because it uses two hands to communicate, while American Sign Language uses one hand to communicate. The use of both hands leads to feature confusion. The limited sources of datasets have resulted in limited effort in detecting Indian Sign Language gestures. This project aims to help in reducing the communication gap between normal people and deaf or dumb people using Indian Sign Language recognition. The project will help in creating a standalone application by which the deaf and dumb will be able to communicate more effectively with the outside world.

1.4 Proposed Solution

This project aims to identify the alphabet and digits in Indian Sign Language's corresponding gestures. The solution will be using images from the live camera input instead of using high technology like hand gloves will are not feasible for the common people and then using deep learning and converting it into textual and speech format.

Chapter 2

Problem Definition and Scope

2.1 Problem statement

To Design and Implement Indian Sign Language Recognition System.

2.2 Goals

Our Goals :

- The Accuracy in the proposed system will be more than 90 Percentage.
- The system will be user-friendly and responsive.
- To identify the symbolic expression and convert it into text and speech.
- To reduce the gap of communication between signers and non-signers.

2.3 Scope and Major Constraints

Scope of our project :

1. To obtain the region of interest from the images by using proper image pre-processing techniques.
2. To achieve the maximum possible accuracy for the system.

3. To develop the system for real-time gesture prediction.

4. To convert the image input into text and speech format.

2.4 Hardware and Software Requirements

Software Requirements:

- Operating System: Linux and Windows
- Language: Python
- Libraries: Keras, OpenCV, Tensorflow
- IDE: Jupiter Notebook
- Algorithm: CNN(classifier), ANN

Hardware Requirements:

- Device: PC or Laptop
- Equipment: Camera

2.5 Action Plan

timeline.jpeg

Chapter 3

Literature Review

Serial No	01
Title	Vison-Based Constant SL Spotting Using Gaussian Hidden Markov Model(HMM)
Date	July 2022
Author	M.K Bhuyan and Anjan Talukdar
Content	The paper suggests that in a novel approach, Hidden Markov Model is used for constant SL spotting. Following the decoding of the state-sequence for identifying the sign components from the sign sequence, the characteristics retrieved from the sign sequence video are used to train a two-state HMM with Gaussian emission probability. To maximise the benefits of each domain, features from both the compressed domain analysis and the pixel domain analysis are integrated..
Merits	The experimental results show that the suggested system can detect the sign frames with an 82 percent spotting rate.

Serial No	02
Title	An Advancement in Speech to SL Translation using 3D Avatar Animator
Date	2020
Author	Bhavinkumar Patel, Harshit Patel, Manthan Khanvilkar, Nidhi Patel, and Thangarajah Akilan, Member, IEEE
Content	This paper describes an engaging system allowing deafness people to communicate effectively. It converts English speech into a 3D avatar animation that depicts Hindi (Indian) language signs rather than GIFs, images, or films to better manage memory. It has a genuine and energetic animation appeal.
Merits	The recommended ES2ISL approach for people with hearing loss is efficient and fast.

Serial No	03
Title	Sign Languages to Speech Conversion Prototype using the SVM Classifier
Date	2019
Author	Malli Chandra ,Rajkumar, Lakshmi Kumar ,Department of ENTC, NIT Puducherry, Karaikal India
Content	This paper suggests of a prototype that comprises of a glove with embedded flex sensors, gyroscopes, and accelerometers. These sensors record the user's real-time actions. The Arduino Nano microcontroller gathers data from these sensors and transmits it to the PC via Bluetooth. The data sent by the Arduino is refined by the PC, which then runs a Machine Learning Algorithm to classify the Sign Language motions and anticipate the word associated with each action..
Merits	With 25 percent testing set and 75 percent training set, the ISL system achieves 100 percent reliability.

Serial No	04
Title	Motionlets Matching With Adaptive Kernels for3-D Indian Sign Language Recognition
Date	15 April 2018
Author	P. Kishore, IEEE, D. Anil, IEEE, A. S. Chandra Sastry, Member, IEEE, and E. Kiran Kumar, IEEE.
Content	This paper suggests a framework for detecting motions in 3D motion recorded data from Indian sign language is described. The framework establishes a two-phase technique for machine translation that handles numerous aspects of 3D sign language motion data. In phase-I, the motion segmented 3D joints' measured trajectories are used to reconstruct the unsorted 3D sign dataset into a 4-class organised motionlet dataset. In a signed frame, each action is physically split into mobility joints and non-mobility joints. Phase-II establishes the shape and direction of 3D motionlets by measuring joint relative distance and joint angle.
Merits	Greater categorization accuracy when compared to state-of-the-art attraction recognition models.

Serial No	05
Title	A Broad Study on Deep Learning-Based Methods for SL Detection
Date	2022
Author	Nikolas, Theocharis, Ilias, Andreas, Georgios Th. Papadopoulos , Member, IEEE, Vassia, George J., Klimnis Atzakas, Dimitris, and Petros Daras, IEEE
Content	This paper discusses sign language detection with a view on projecting non-segmented video feeds to glosses. Two novel sequence training criteria from the disciplines of speech and scene text recognition are presented for this challenge. A variety of explicit training strategies are also thoroughly covered. Finally, a new RGB+D database is developed for Greek sign language. To the best of our knowledge, this is the first sign language database with three classification levels for the same set of video recordings (individual gloss, sentence, and spoken language).
Merits	In the majority of the CSLR collections, 2D CNN-based systems with an intermediate per gloss representation performed better than independent SLR approaches.

Serial No	06
Title	Early approximate system for 3D-discrete Indian SL detection using graph matching
Date	2021
Author	E. Kiran, P. Kishore , D. Anil, M. Teja Kiran
Content	Their paper clarifies a platform to challenges found in sign language machine translation. The two issues addressed are inconsistent frame rates during real-time capturing and distinguishing noisy hand gestures from true sign. On 3D sign language data acquired using 3D motion capture technology, these two difficulties are handled utilising graph matching techniques.
Merits	75 percent quicker. The documented recognition rate is 98, percent which is 8 percent higher than the normal graph matching models given for 3D gesture recognition.

Serial No	07
Title	CNN based Adaptive Gesture Detection for Indian SL Modeling
Date	2021
Author	Dushyant Singh CSED, MNNIT, Prayagraj-211003, India
Content	Their paper suggests that they wanted to build a deep neural network that could train and detect standard Indian SL hand motions. They gathered the data from people of various ages and from different cultural backgrounds. For analysing the sculpting activity for adaptive motions, the core 3D- CNN architecture is applied.
Merits	Experimental findings validate system performance via high detection rates.

Serial No	08
Title	Indian SL detection system using SURF with SVM and CNN
Date	2022
Author	Shagun Katoch (a), Varsha Singh (b) , Uma Tiwary (b) a) CS, NIT, Hamirpur, India b) Department of IT, IIIT, Allahabad, India
Content	The paper suggests that how they demonstrate a system that recognises Indian sign language alphabets (A-Z) and numerals (0-9) in a live video feed and outputs the expected labels as text and audio. Skin colour and background subtraction are used for segmentation. The photos have had SURF (Speeded Up Robust Features) features extracted from them, and histograms have been created to map the signs with appropriate labels. For classification, Support Vector Machines (SVM) and Convolutional Neural Networks (CNN) are utilised. For ease of use, an interactive GUI is also created.
Merits	The approach has been trained with 99 percent accuracy on all 36 ISL static alphabets and digits.

Chapter 4

System Requirement Specification

4.1 Overall Description

The requirements are explained in this chapter. It specifies the hardware and software requirements that need to be met for the application to operate correctly.

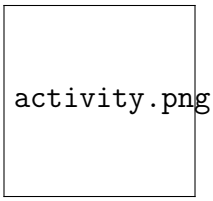
The Software Requirements Specification (SRS) covers the functional and non-functional requirements. Every data, functional, and behavioral requirement for the software that is in production or development is detailed in an SRS document. The SRS is a vital document that serves as the foundation for the software development process vital. It provides a thorough explanation of how the system's behavior will be evolved. It includes a description of its key features in addition to a list of the system requirements. These tasks are part of requirements analysis in systems engineering and software engineering.

The SRS serves as a blueprint for the project and is referred to as the 'mother' document of the project. It includes design specifications, statements of work, and software architecture documents.

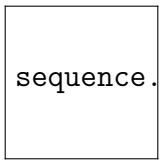
4.2 Modeling

4.2.1 Use Case Diagram

4.2.2 Activity Diagram



4.2.3 Sequence Diagram



Chapter 5

Proposed Methodology

5.1 Implementation

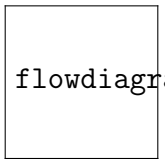
The following steps will be used to implement the project.

1. The dataset is acquired from an available source.
2. Image processing is used to convert images into pixels.
3. Dataset is divided into train and test data in order to train the data.
4. Model is created for the real-time detection for the gestures and deployed in the form of web application.
5. Classification accuracy will be used to compare the output of these algorithms.

5.1.1 Data flow Diagram

0-level DFD

1-level DFD



Chapter 6

Conclusion

6.1 Conclusion

The main motive of the project is to demonstrate the recognition of gestures in the Indian Sign Language used by deaf and dumb people. Image processing and speech conversion are used in the project to accurately perform the task of interpreting the signs of the language. The created model is deployed in the form of a web app.

Chapter 7

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