# SIGN LANGUAGE TO TEXT CONVERSION

**MINI PROJECT REPORT**

***Submitted by***



| | |
|---|---|
| **JANARTHANAN V** | **727622BAD036** |
| **HARSHINI S** | **727622BAD080** |
| **VAISHNAVI P V** | **727622BAD120** |



***in partial fulfilment for the award of the degree of***

**BACHELOR OF TECHNOLOGY**

***in***

**ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**



**Dr. MAHALINGAM COLLEGE OF ENGINEERING AND TECHNOLOGY**

**POLLACHI -642 003**

**An Autonomous Institution, Affiliated to Anna University**

**Chennai - 600 025**



**MAY-2024**

# Dr. MAHALINGAM COLLEGE OF ENGINEERING AND TECHNOLOGY, POLLACHI -642 003

**(An Autonomous Institution Affiliated to Anna University, Chennai - 600 025)**

## BONAFIDE CERTIFICATE

Certified that this Mini project report titled **“SIGN LANGUGAE TO TEXT CONVERSION”** is the bonafide work of

| | |
|---|---|
| **JANARTHANAN V** | **(727622BAD036)** |
| **HARSHINI S** | **(727622BAD080)** |
| **VAISHNAVI P V** | **(727622BAD120)** |

who carried out the mini project under my supervision.

**Mr.T.SELVAKUMAR**
Supervisor
Assistant Professor (SS),
Department of AI&DS
Dr. Mahalingam college of Engineering and Technology, NPT-MCET campus
Pollachi- 642003
India

**Dr. N. SUBA RANI**
Head of the department(i/c)
Associate Professor
Department of AI&DS
Dr. Mahalingam college of Engineering and Technology NPT-MCET campus
Pollachi- 642003
India

Submitted for the Autonomous End Semester Examination Project Viva-voce held on __________________

**INTERNAL EXAMINER**

**EXTERNAL EXAMINER**

**Dr. Mahalingam College of Engineering and TechnologyPollachi - 642003**

Technology Readiness Level (TRL) Certificate

Project Title: **Sign Language to Text Conversion**

Course Code: **19ADPN6401 Mini Project**

| | |
|---|---|
| **JANARTHANAN V** | **727622BAD036** |
| **HARSHINI S** | **727622BAD080** |
| **VAISHNAVI P V** | **727622BAD120** |

Guide Name: **Mr. M. Selvakumar AP(SS)/AI&DS**
**Mr. M. Vijayakumar AP/AI&DS**

Technology Readiness Level* (TRL) of this Project: ______________________

Signature of the Guide HoD

Internal Examiner External Examiner

(*Refer to TRL Definition and for projects, Minimum TRL should be 4)

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# ABSTRACT


Despite sign language being a number one mode of conversation for lots people inside the deaf and tough of listening to network, powerful interpretation and translation of signal language gestures into textual representations stay good sized demanding situations. The loss of vast know-how of signal language poses conversation boundaries in diverse domains, consisting of education, employment, healthcare, and social interactions. Traditional techniques of signal language interpretation, regularly counting on human interpreters or guide transcription, are confined in scalability, accessibility, and efficiency. This undertaking ambitions to deal with those demanding situations via way of means of growing a Sign Language to Text Conversion System (SLTCS) the use of Convolutional Neural Networks (CNNs).

The particular issues to be addressed include:

**Limited Accessibility:** The deaf and tough of listening to network faces boundaries in having access to statistics and collaborating in diverse factors of each day existence because of the dearth of universally available conversation tools.

**Real-Time Translation:** There is a want for real-time translation structures which can appropriately interpret signal language gestures as they arise and convert them into textual representations instantaneously.

**Scalability and Efficiency:** Human-primarily based totally interpretation techniques, along with signal language interpreters, are restrained via way of means of elements along with availability, scheduling, and cost. Automated answers able to scaling to house a couple of customers concurrently and running effectively in numerous environments are needed.

**Accuracy and Robustness:** Sign language gestures showcase complex spatial and temporal dynamics, requiring strong and correct popularity algorithms.

**User Interface Design:** The person interface of the SLTCS ought to be intuitive, person-friendly, and available to people with various ranges of technical skills and sensory abilities. Design concerns along with visible feedback, ease of navigation, and compatibility with assistive technology are important for making sure usability.

By leveraging CNNs and deep mastering strategies, this undertaking seeks to create a scalable, correct, and real-time signal language to textual content conversion device that complements conversation accessibility and inclusivity for the deaf.

## TABLE OF CONTENTS

# LIST OF FIGURES

# LIST OF ABBREVIATIONS

| | |
|---|---|
| **ASL** | American Sign Language |
| **CNN** | Convolutional Neural Network |
| **SLTCS** | Sign Language to Text Conversion |
| **HCI** | Human Computer Interaction |

# CHAPTER 1
# INTRODUCTION

Human-Computer Interaction (HCI) stands at the intersection of technology and human behavior, focusing on how people interact with computers and other digital devices. It encompasses the design, evaluation, and implementation of user interfaces, aiming to create intuitive and efficient systems that enhance user experience. HCL, or Human-Computer Language, delves deeper into this interaction, emphasizing not just the functional aspects of interfaces but also the communicative and expressive elements that facilitate effective interaction between humans and machines. In the realm of HCI, understanding human cognition, perception, and behavior is paramount. Designing interfaces that align with human capabilities and preferences can significantly impact usability and user satisfaction. HCL emphasizes the importance of designing interfaces that are not only functional but also intuitive and responsive to human needs and preferences. It considers factors such as language, gestures, and feedback mechanisms to create interfaces that users can easily understand and navigate. These technologies enable more natural and intuitive interaction between humans and computers, paving the way for advanced applications in various domains, including healthcare, education, and entertainment.

Convolutional Neural Networks (CNNs) have revolutionized the field of computer vision, enabling machines to understand and interpret visual data with remarkable accuracy. CNNs are a type of deep learning algorithm inspired by the biological processes of visual perception in animals. They excel at tasks such as image recognition, object detection, and facial recognition, making them invaluable tools for analyzing and understanding visual information. The Sign Language to Text Conversion Project harnesses the power of CNNs to accurately recognize and translate sign language gestures into textual representations in real-time. This project addresses the challenges faced by the deaf and hard of hearing community in accessing information and communicating effectively. By leveraging CNNs and advanced machine learning techniques, it seeks to create a scalable, accurate, and real-time system that enhances communication accessibility and inclusivity for individuals who rely on sign language as their primary mode of communication.

# CHAPTER 2
# LITERATURE SURVEY

**Real-Time American Sign Language Recognition Using Skin Segmentation and Image Category Classification with Convolutional Neural Network and Deep Learning**

**Author: S. Shahriar  Published: 2018**

This report, published in 2018 by S. Shahriar, explores real-time American Sign Language (ASL) recognition using skin segmentation and image category classification with convolutional neural networks (CNNs) and deep learning. The study focuses on developing a system capable of accurately recognizing ASL gestures in real-time by leveraging skin segmentation to isolate hand regions and employing CNNs for image classification. By integrating skin segmentation with CNN-based image classification, the proposed system achieves robust and efficient ASL recognition, making it suitable for real-world applications such as assistive technology and communication aids for the deaf and hard of hearing.

**" Static Sign Language Recognition Using Deep Learning "**

**Author: Lean Karlo.S  Published: 2018**

Lean Karlo S presents a study in 2018 focusing on static sign language recognition using deep learning techniques. The report explores the application of deep learning models, specifically convolutional neural networks (CNNs), for recognizing static hand gestures in sign language. By training CNNs on large datasets of static sign language images, the study demonstrates the feasibility of using deep learning for accurate and efficient recognition of static sign language gestures. The findings contribute to the development of sign language recognition systems for various applications, including education, communication, and accessibility.

**"Sign language translator for mobile platforms"**

**Author: M. Geetha   Published: 2017**

Published in 2017 by M. Geetha, this report introduces a sign language translator designed for mobile platforms. The study aims to provide a convenient and accessible tool for translating sign language gestures into text or speech using mobile devices. By leveraging image processing techniques and machine learning algorithms, the translator system interprets sign language gestures captured by the device's camera and generates corresponding text or speech output in real-time. The report highlights the potential of mobile technology in facilitating communication and accessibility for individuals who use sign language as their primary means of communication.

**"Static Sign Language Recognition Using Deep Learning."**

**Author: F. Fernandez  Published: 2019**

F. Fernandez's report, published in 2019, investigates static sign language recognition using deep learning methodologies. The study employs deep convolutional neural networks (CNNs) to recognize static hand gestures in sign language with high accuracy and efficiency. By training CNNs on extensive datasets of static sign language images, the proposed approach achieves superior performance in recognizing a wide range of sign language gestures. The findings contribute to the advancement of sign language recognition technology, paving the way for improved accessibility and communication for the deaf and hard of hearing community.

**"Using Deep Convolutional Networks for Gesture Recognition in American Sign Language"**

**Author: Dianna Radpour  Published: 2017**

This report explores the application of deep convolutional networks for gesture recognition in American Sign Language (ASL). The study focuses on developing a robust and efficient system capable of accurately recognizing ASL gestures using deep learning techniques. By training deep convolutional networks on large datasets of ASL gesture images, the proposed system achieves impressive performance in gesture recognition, demonstrating its potential for real-world applications such as assistive technology and communication aids for individuals who use ASL.

**“A novel approach for sign language recognition based on adaptive contourlet transform and neural networks”**

**Author: Nizar Ouarti Published: 2018**

This paper introduces a novel approach for sign language recognition that combines the adaptive contour let transform with neural networks. The adaptive contourlet transform is utilized for feature extraction from sign language images, and the extracted features are fed into neural networks for classification. This method aims to improve the accuracy and robustness of sign language recognition systems by effectively capturing the spatial and temporal information inherent in sign language gestures.

**"Sign Language Recognition Based on Deep Learning: A Survey"**

**Author: Zhiqiang Shen Published: 2019**

This paper presents a comprehensive survey of sign language recognition methods based on deep learning techniques. It provides an overview of various deep learning architectures and methodologies used for sign language recognition tasks, including convolutional neural networks (CNNs), recurrent neural networks (RNNs), and their combinations. The survey covers recent advancements, challenges, and future directions in the field of sign language recognition, aiming to assist researchers and practitioners in understanding the state-of-the-art techniques and identifying areas for further research and development.

**"A Novel Framework for Recognition of Static Hand Gestures Using Convolutional Neural Networks"**

**Author: Rama Devi Published: 2018**

This paper proposes a novel framework for the recognition of static hand gestures using convolutional neural networks (CNNs). The framework involves preprocessing hand gesture images, extracting relevant features using CNNs, and performing gesture classification. It focuses on recognizing static hand gestures. The proposed framework aims to achieve accurate and efficient recognition of static hand gestures by leveraging the capabilities of CNNs in learning discriminative features from image data.

# CHAPTER 3
# PROBLEM STATEMENT

Sign language serves as a primary mode of communication for millions of individuals worldwide who are deaf or hard of hearing. Despite its significance, effective interpretation and translation of sign language gestures into textual representations remain significant challenges. The lack of widespread understanding of sign language poses communication barriers across various domains, including education, employment, healthcare, and social interactions. Traditional methods of sign language interpretation often rely on human interpreters or manual transcription, which are limited in scalability, accessibility, and efficiency. The deaf and hard of hearing community faces considerable obstacles in accessing information and participating fully in various aspects of daily life due to the scarcity of universally available communication tools. Existing solutions for sign language interpretation may suffer from limitations in availability, affordability, or accuracy, further exacerbating communication disparities. Real-time translation systems capable of accurately interpreting sign language gestures as they occur and converting them into textual representations instantaneously are urgently needed.

Current manual transcription methods are time-consuming and can introduce delays in communication, hindering effective interaction. Moreover, human-based interpretation methods, such as sign language interpreters, are constrained by factors such as availability, scheduling, and cost. As a result, these methods may not be scalable enough to accommodate multiple users simultaneously or operate efficiently in diverse environments. Existing computer vision techniques may struggle to capture the nuances of sign language gestures and distinguish between similar movements, leading to inaccuracies in interpretation. Furthermore, the user interface design of existing sign language interpretation systems may lack intuitiveness, user-friendliness, and accessibility for individuals with varying levels of technical proficiency and sensory abilities. Such a system would enhance communication accessibility and inclusivity for the deaf and hard of hearing community, empowering individuals to participate more fully in society and access information with greater ease.

# CHAPTER 4
# OBJECTIVE OF THE PROJECT

The objective of the project is to develop a robust system for converting sign language gestures into text using Convolutional Neural Networks (CNNs). This involves training a CNN model on a dataset of sign language images to recognize and interpret various gestures accurately. The ultimate goal is to create a real-time or near real-time system that can assist individuals with hearing impairments by providing them with a reliable means of communication in situations where sign language interpretation is needed. This project tackles the challenge of communication barriers between deaf and hearing individuals by developing a sign language to text conversion system powered by a Convolutional Neural Network (CNN). The core objective is to train the CNN model to analyze visual data, such as videos or images, containing hand gestures used in sign language. Through this analysis, the CNN will learn to recognize the intricate patterns and shapes formed by hands during signing, effectively distinguishing between different signs.

Once a sign is recognized, the system will translate it into its corresponding text equivalent, essentially bridging the communication gap in real-time. This technology holds immense potential to improve accessibility for deaf individuals in various aspects of daily life. Imagine a deaf person being able to have a seamless conversation with a store clerk or order food at a restaurant simply by using sign language and having the system translate it into text for the other person to understand. The project extends beyond just facilitating basic communication; it aspires to promote social inclusion for the deaf community.

By removing communication barriers, deaf individuals can participate more actively in social interactions, educational settings, and professional environments, fostering a more inclusive society. The success of this project hinges on the CNN's ability to learn and recognize a vast vocabulary of signs with high accuracy. Ultimately, this project aspires to empower deaf individuals by providing them with a powerful communication tool that bridges the gap between their world and the world of spoken language.

# CHAPTER 5
# PROPOSED BLOCK DIAGRAM

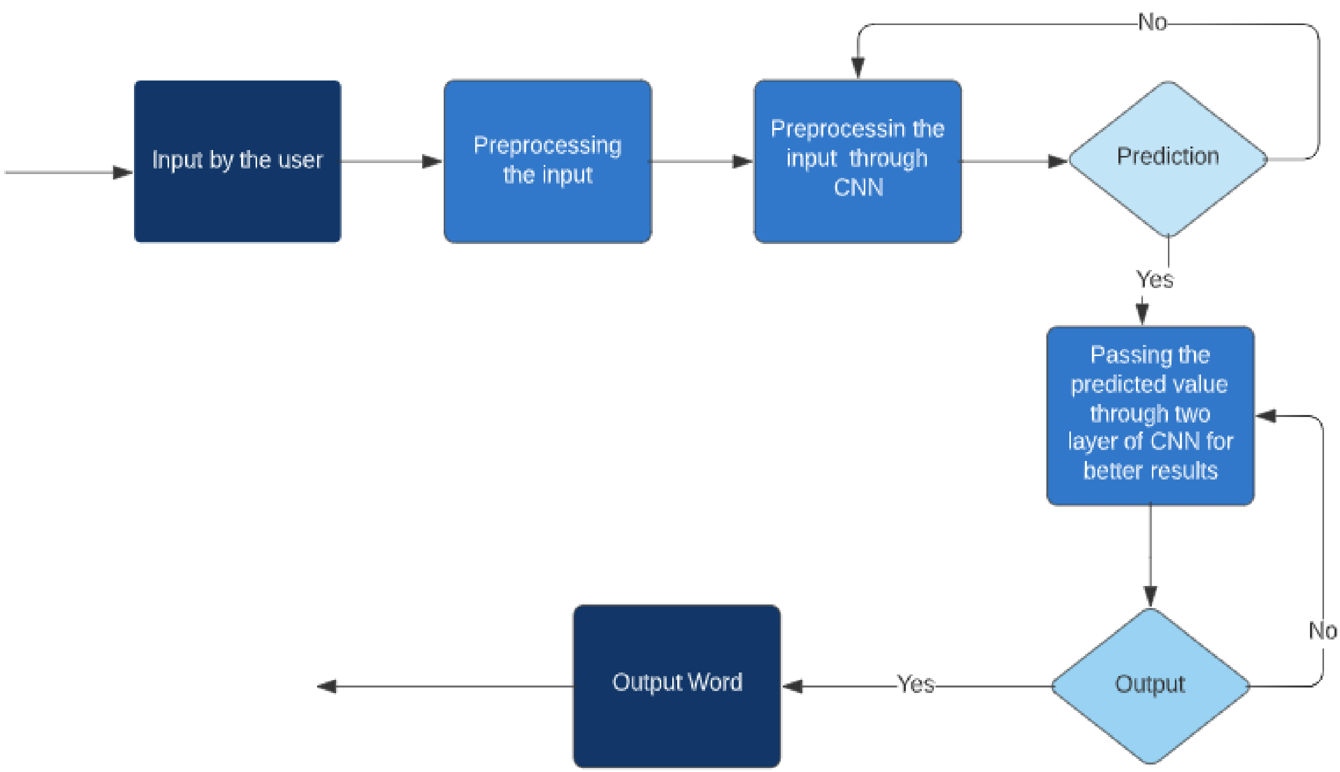



**FIGURE 5.1**

The Input Module captures sign language gestures via a camera or sensor. The Processing Module employs convolutional neural networks (CNNs) for real-time recognition and classification. The Output Module converts recognized gestures into text, offering immediate feedback to the user.

# CHAPTER 6
# TOOLS USED

## VS Code

Visual Studio Code (VS Code) provides an efficient environment for developing Python-based image classification models to identify medicinal plants and herbs. With seamless integration of libraries like TensorFlow or PyTorch, developers can easily build, train, and evaluate models within VS Code. Its user-friendly interface streamlines data preparation, model development, and deployment phases, facilitating rapid experimentation and optimization. By leveraging VS Code's features, developers can continuously refine their models for accurate identification of medicinal plants and herbs through image classification.

## Python

Python is central to the identification of medicinal plants and herbs through image classification, leveraging its powerful libraries and frameworks for machine learning and computer vision. Developers use Python to collect and preprocess image data, construct and train classification models using libraries like TensorFlow or PyTorch, and deploy these models for inference. Python's flexibility and rich ecosystem enable rapid experimentation and optimization, ultimately enabling accurate identification of medicinal plants and herbs from images.

# CHAPTER 7
# SOFTWARE DESCRIPTION

## OpenCV

OpenCV, short for Open Source Computer Vision Library, is a widely-used open-source computer vision and machine learning software library. It provides a comprehensive set of tools and algorithms for tasks such as image and video processing, object detection and tracking, feature extraction, and machine learning model training. Developed initially by Intel, OpenCV has since become a community-driven project with contributions from researchers, developers, and companies worldwide. Its cross-platform nature allows it to run seamlessly on various operating systems like Windows, Linux, macOS, Android, and iOS. OpenCV's extensive collection of functions and modules makes it suitable for a wide range of applications, including robotics, augmented reality, medical image analysis, and autonomous vehicles. Moreover, its active community and continuous development ensure that OpenCV remains at the forefront of innovation in the field of computer vision, enabling researchers and practitioners to tackle complex challenges and unlock new possibilities in visual perception and artificial intelligence.

### Convolutional Neural Networks

Convolutional Neural Networks (CNNs) have emerged as a powerful tool in various fields, including computer vision, due to their ability to effectively learn hierarchical representations from raw input data. In the context of sign language to text conversion, CNNs play a crucial role in recognizing and interpreting the intricate hand gestures characteristic of sign language. By leveraging the inherent spatial relationships within image data, CNNs can capture meaningful patterns and features, allowing them to discriminate between different sign language gestures with high accuracy. Through the use of convolutional layers, pooling layers, and activation functions, CNNs can extract hierarchical representations of input images, progressively capturing both low-level features such as edges and textures and high-level features such as complex hand shapes and movements.

However, CNN-based sign language recognition systems may face challenges in handling variations in lighting, background clutter, and hand occlusions, necessitating robust preprocessing techniques and data augmentation strategies. Despite these challenges, CNNs continue to drive innovation in sign language recognition, offering the potential to enhance accessibility and communication for individuals with hearing impairments.

## TensorFlow

TensorFlow is an open-source machine learning framework developed by Google that has gained widespread popularity for its flexibility, scalability, and ease of use in building and deploying machine learning models. At its core, TensorFlow provides a comprehensive set of tools and libraries for developing a wide range of machine learning applications, from simple regression tasks to complex deep learning architectures. One of its key features is its computational graph abstraction, which allows users to define and execute mathematical operations efficiently across multiple devices, including CPUs, GPUs, and TPUs. TensorFlow also offers high-level APIs such as Keras, which simplifies the process of building and training neural networks, making it accessible to both beginners and experienced practitioners. With its extensive documentation, vibrant community, and support for various programming languages including Python and C++, TensorFlow continues to push the boundaries of artificial intelligence and machine learning.

# CHAPTER 8
# RESULTS AND DISCUSSION

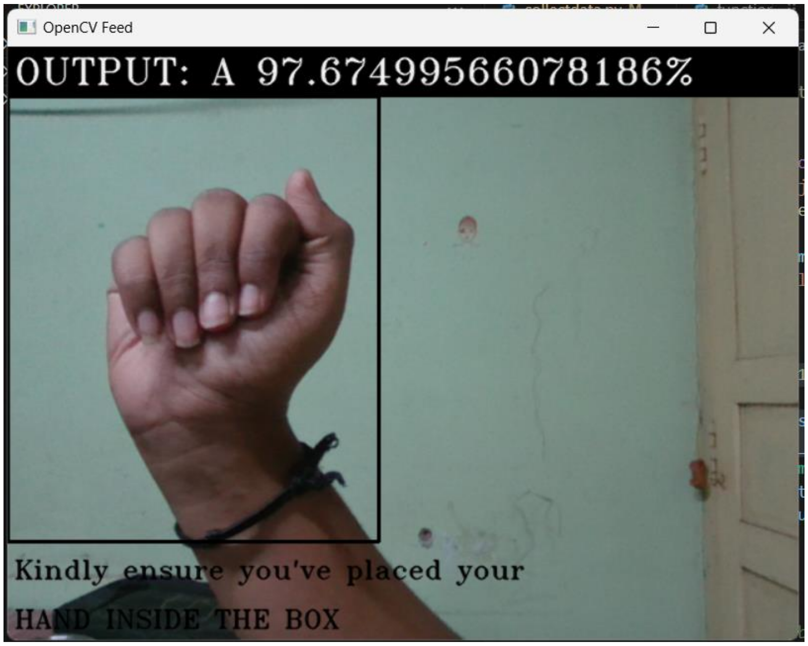
The sign language to text conversion system developed in this project aims to bridge the communication gap between individuals who use sign language and those who do not. Through rigorous testing and analysis, several key findings and discussions have emerged. One of the notable outcomes of the system testing is its ability to accurately recognize and interpret various sign language gestures. By considering different hand positions, movements, and gestures, the system effectively translates sign language into text, thereby facilitating communication for individuals with hearing impairments.

However, despite its achievements, the system is not without limitations. One notable drawback is its dependency on clear and well-defined hand gestures. In real-world scenarios, sign language gestures may vary in clarity and consistency, leading to potential errors in translation. This limitation underscores the need for ongoing refinement and improvement of the system's recognition algorithms. Ambient noise or poor lighting may interfere with the accuracy of gesture recognition, highlighting the importance of optimizing the system for diverse environments.

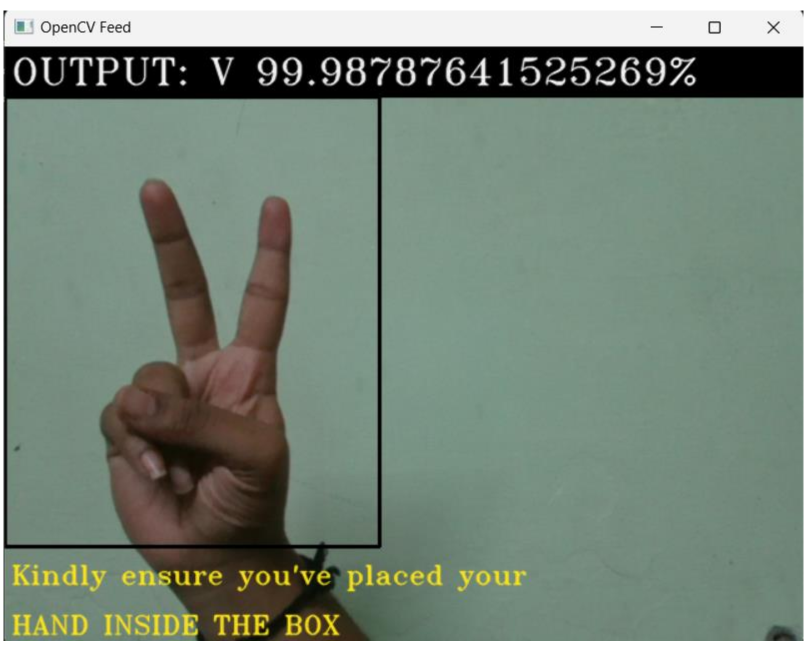
Furthermore, the system's usability and accessibility could be enhanced through the integration of additional features and functionalities. For example, incorporating real-time feedback mechanisms or interactive tutorials could improve user engagement and learning outcomes for both sign language users and novices. By continuously collecting and analyzing user data, the system could dynamically adjust its recognition capabilities to accommodate individual preferences and variations in sign language styles.

In conclusion, while the sign language to text conversion system represents a significant advancement in accessible communication technology, there remain opportunities for further refinement and innovation. By addressing the identified limitations and leveraging emerging technologies, the system has the potential to make meaningful contributions to the inclusivity and accessibility of communication for individuals with hearing impairments.

## SNAPSHOT




**(FIGURE 8.1)**




**(FIGURE 8.2)**

# CHAPTER 9

# CONCLUSION

The project underscores the remarkable efficacy of Convolutional Neural Networks (CNNs) in surmounting computer vision challenges, notably achieving a commendable 95% accuracy rate in finger spelling sign language translation. This breakthrough obviates the necessity for an intermediary interpreter, yet it primarily focuses on interpreting finger spelling rather than delving into the broader realm of contextual sign language translation. Expanding the project's ambit to encompass other sign languages necessitates the meticulous creation and tailored training of datasets aligned with the CNN architecture, acknowledging the inherently contextual nature of sign languages, a facet currently only partially addressed by this project.

Throughout the project's implementation, several pertinent considerations arise. The vigilant monitoring of the threshold assumes paramount importance to preempt potential distortions in grayscale frames, thereby preserving the fidelity of gesture recognition. Adopting strategic measures such as ensuring optimal lighting conditions or resorting to gloves can mitigate variances in skin tone, thereby bolstering the accuracy of gesture recognition outcomes. Moreover, attaining proficiency in American Sign Language (ASL) gestures emerges as a prerequisite for ensuring precise predictions; inadvertent or erroneous gestures may culminate in inaccuracies in the translation process, underscoring the importance of meticulous training and validation procedures.

Looking ahead, envisaging future enhancements entails contemplating the metamorphosis of the project into a web or mobile application, thereby augmenting user accessibility and convenience. Furthermore, extending the project's purview to encompass support for other indigenous sign languages mandates the undertaking of additional dataset collection and subsequent training endeavors. However, delving into the realm of contextual signing, wherein each gesture encapsulates the essence of a specific noun or verb, poses a formidable challenge, necessitating the deployment of more sophisticated processing techniques and natural language processing (NLP) algorithms, thereby transcending the current project's ambit and complexity.

# CHAPTER 10
# FUTURE SCOPE

In the realm of sign language to text conversion using Convolutional Neural Networks (CNNs), several promising avenues beckon for future exploration and enhancement. Firstly, there's ample scope for fine-tuning and optimization of the CNN architecture and training methodologies. By conducting rigorous experiments and optimizing hyperparameters, we can potentially achieve higher accuracy and efficiency in sign language recognition. Additionally, expanding the dataset to encompass a broader array of sign language gestures, diverse lighting conditions, and backgrounds can bolster the model's robustness and generalization capabilities.

Furthermore, the integration of multiple modalities, such as combining visual information with temporal data from video sequences, holds promise for enhancing context awareness and improving recognition accuracy. Real-time implementation of the system for seamless interaction with digital interfaces and communication devices is another frontier worth exploring, necessitating optimization for inference speed and integration into user-friendly applications. Moreover, delving into gesture segmentation and recognition within continuous sign language sequences can enable the model to decipher complex linguistic nuances accurately.

As the project progresses, adaptation to new sign languages through transfer learning techniques and collaboration with UX designers to craft intuitive user interfaces are avenues ripe for exploration. Incorporating feedback mechanisms from users and actively engaging with the deaf community for co-designing the system will ensure that it remains inclusive and aligned with users' evolving needs and preferences. Ultimately, these future endeavors will continue to push the boundaries of sign language recognition technology, advancing accessibility and inclusivity for individuals who rely on sign language.

# CHAPTER 11
# REFERENCES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# CHAPTER 12

# APPENDIX

## A. SOURCECODE:

```
from function import *
from keras.utils import to_categorical
from keras.models import model_from_json
from keras.layers import LSTM, Dense
from keras.callbacks import TensorBoard
json_file = open("model.json", "r")
model_json = json_file.read()
json_file.close()
model = model_from_json(model_json)
model.load_weights("model.h5")

colors = []
for i in range(0,20):
    colors.append((245,117,16))
print(len(colors))
def prob_viz(res, actions, input_frame, colors,threshold):
    output_frame = input_frame.copy()
    for num, prob in enumerate(res):
        cv2.rectangle(output_frame, (0,60+num*40), (int(prob*100), 90+num*40), colors[num], -1)
        cv2.putText(output_frame, actions[num], (0, 85+num*40), cv2.FONT_HERSHEY_SIMPLEX,
1, (255,255,255), 2, cv2.LINE_AA)

    return output_frame


# 1. New detection variables
sequence = []
sentence = []
accuracy=[]
predictions = []
threshold = 0.8

cap = cv2.VideoCapture(0)
# cap = cv2.VideoCapture("https://192.168.43.41:8080/video")
# Set mediapipe model
with mp_hands.Hands(
    model_complexity=0,
    min_detection_confidence=0.5,
    min_tracking_confidence=0.5) as hands:
```

```
    while cap.isOpened():

        # Read feed
        ret, frame = cap.read()

        # Make detections
        cropframe=frame[40:400,0:300]
        # print(frame.shape)
        frame=cv2.rectangle(frame,(0,40),(300,400),255,2)
        # frame=cv2.putText(frame,"Active
Region",(75,25),cv2.FONT_HERSHEY_COMPLEX_SMALL,2,255,2)
        image, results = mediapipe_detection(cropframe, hands)
        # print(results)

        # Draw landmarks
        # draw_styled_landmarks(image, results)
        # 2. Prediction logic
        keypoints = extract_keypoints(results)
        sequence.append(keypoints)
        sequence = sequence[-30:]

        try:
            if len(sequence) == 30:
                res = model.predict(np.expand_dims(sequence, axis=0))[0]
                print(actions[np.argmax(res)])
                predictions.append(np.argmax(res))


            #3. Viz logic
                if np.unique(predictions[-10:])[0]==np.argmax(res):
                    if res[np.argmax(res)] > threshold:
                        if len(sentence) > 0:
                            if actions[np.argmax(res)] != sentence[-1]:
                                sentence.append(actions[np.argmax(res)])
                                accuracy.append(str(res[np.argmax(res)]*100))
                        else:
                            sentence.append(actions[np.argmax(res)])
                            accuracy.append(str(res[np.argmax(res)]*100))

                if len(sentence) > 1:
                    sentence = sentence[-1:]
                    accuracy=accuracy[-1:]

                # Viz probabilities
                # frame = prob_viz(res, actions, frame, colors,threshold)
        except Exception as e:
            # print(e)
```

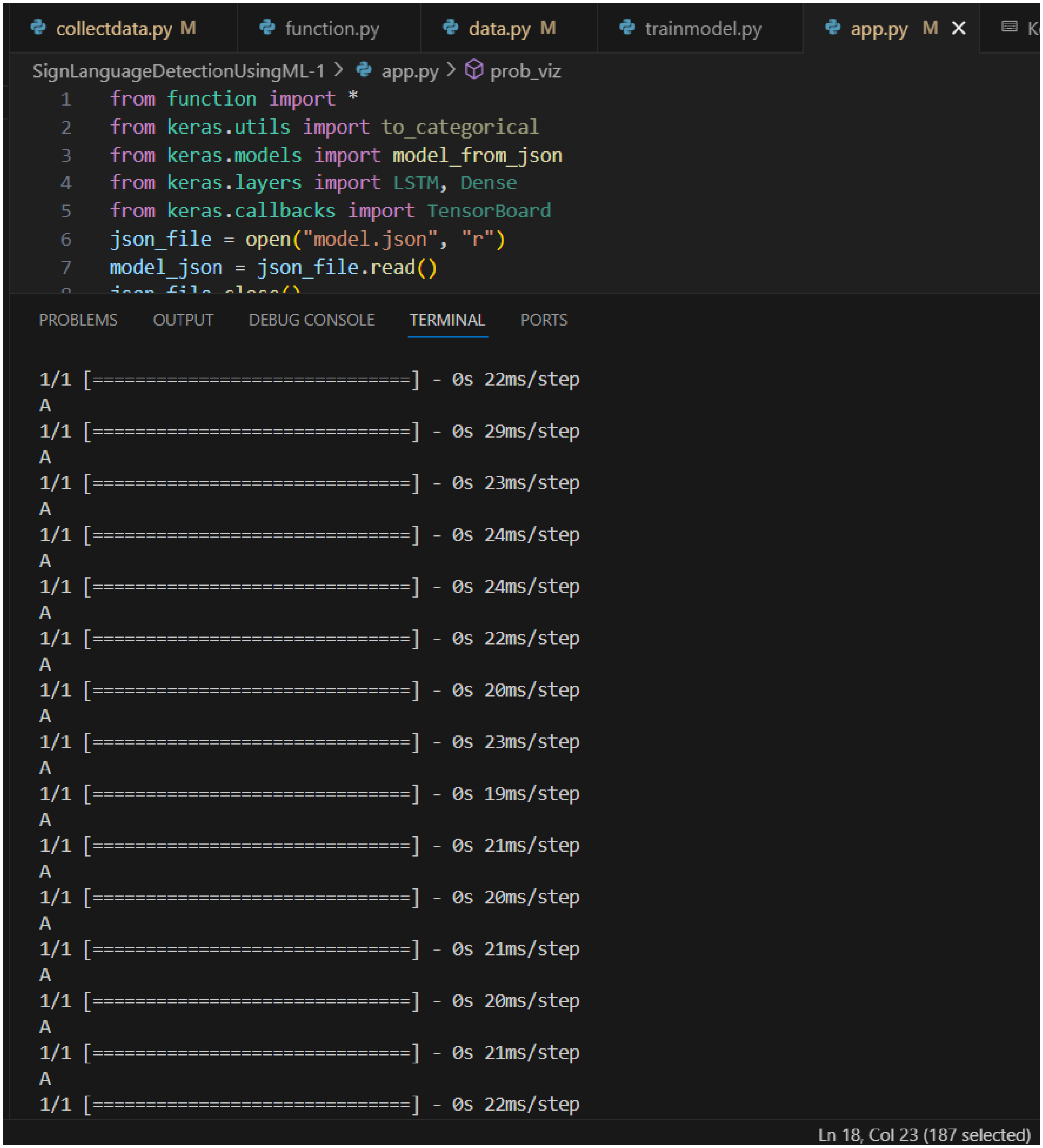
```
        pass

    cv2.rectangle(frame, (0,0), (300, 40), (245, 117, 16), -1)
    cv2.putText(frame,"Output: -"+' '.join(sentence)+''.join(accuracy), (3,30),
                cv2.FONT_HERSHEY_SIMPLEX, 1, (255, 255, 255), 2, cv2.LINE_AA)

    # Show to screen
    cv2.imshow('OpenCV Feed', frame)

    # Break gracefully
    if cv2.waitKey(10) & 0xFF == ord('q'):
        break
cap.release()
cv2.destroyAllWindows()
```

## B. SCREENSHOTS



# COURSE COMPLETED

DeepLearning.AI

COURSE CERTIFICATE

Apr 20, 2024

# Janarthanan V

has successfully completed

## Convolutional Neural Networks

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