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KANNADA SIGN LANGUAGE RECOGNITION USING HAND GESTURES

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Abstract - *Sign language serves as a crucial mode of communication for individuals with hearing impairments, facilitating their interaction and integration into society. Recognizing the gestures and movements of Learning sign language is difficult because of the complexity of sign language. In this paper, we will introduce a new method of Kannada sign language recognition using machine learning. The proposed system is employs a comprehensive dataset of Kannada sign language gestures, capturing a diverse range of hand configurations and movements. Preprocessing techniques are applied to enhance the quality and consistency data, including standardization and feature extraction. Machine learning algorithms, including CNNs, are used to train and classification tasks. CNNs are utilized for spatial feature extraction from image-based data. The system achieves high classification accuracy rates, thus showing promise for practical deployment in real-world applications. Furthermore, the system's adaptability and scalability make it suitable for accommodating additional gestures and improving performance over time. This research makes strides in enhancing accessibility and inclusivity for people with hearing impairments by offering an effective and dependable method. It employs machine learning techniques to aid in the recognition of Kannada sign language.*

Key Words: **Sign Language, CNN, Gesture, Machine Learning, Hand, Movements**

1. INTRODUCTION

The introduction outlines the imperative for systems capable of recognizing Kannada Sign Language (KSL) gestures, highlighting the existing gap in communication between KSL users and non-signers. KSL serves as a crucial mode of communication for the Deaf community in Karnataka, India, reflecting the region's linguistic and cultural heritage. However, developing accurate systems for recognizing KSL gestures poses a significant technological challenge. Integrating machine learning and deep learning, particularly through frameworks like TensorFlow and Media Pipe, offers a promising solution to bridge this communication gap. The complexity of KSL lies in its diverse gestures, involving variations in hand shapes, movements, and expressions, requiring advanced computational methods for real-time interpretation. Machine learning, combined with deep learning models, has emerged as a transformative approach, enabling the creation of robust systems with high accuracy in recognizing KSL gestures. TensorFlow, an open-source library, is notable for its flexibility and scalability in implementing deep learning architectures, particularly convolutional neural networks (CNNs), essential for understanding sequential and spatial patterns inherent in KSL.

1.1 PROBLEM DEFINITION

Traditional Kannada sign language recognition relies on hand recognition, aiding communication between hearing and deaf individuals. Our project innovatively combines sign and behavioral signals, improving communication clarity and security. Using multiple instance learning algorithms, we attain higher accuracy in understanding signs, facilitating effective communication with deaf and mute individuals, conveying letters, words, or intentions. Our software recognizes hand gestures, computing parameters to interpret human communication accurately, determining the individual's communication state through static gestures analysis.

1.2 OBJECTIVE

The main objective of our project is to ensure the communication experience as complete a possible for both hearing and deaf people. The work presented in Indian Regional language, Kannada, the system to develop system's for automatic translation and static gestures of alphabets in Kannada sign language. Signs of the deaf individual can be recognized and translated in Kannada language for the benefit of deaf & dumb people.

1.3 SCOPE

The Communication forms a very important and basic aspect of our lives. Whatever we do, whatever we say, somehow does reflect some of our communication, though it want be directly. To understand the very fundamental behavior of a human, we will analyze this communication through some hand gesture, also called, the affect data. Data can be sign, image etc. Using this communicational data for recognizing the gesture also forms an interdisciplinary field, called Affective Computing. This paper summarizes the previous works done in gesture recognition based on various sign models and computational approaches.

2. LITERATURE SURVEY

[A]Title:- New Methodology for Translation of Static Sign Symbol to Words in Kannada Language.
Authors: Ramesh M. Kagalkar, Nagaraj H.N
Publication Journal & Year:- IRJET-2021.

Summary: The objective of this paper is to design a system for automatically translating static gestures of the Kannada sign language alphabet. This system aims to associate letters, words, and expressions in a specific language with a set of hand gestures, facilitating communication for individuals through hand gestures rather than spoken language. Additionally, a system capable of recognizing these signing symbols could serve as a means of communication with individuals who are hard of hearing.

[B]Title: Sign language Recognition Using Machine Learning Algorithm.
Authors: Prof. Radha S.
Publication Journal & Year:-IEEE, 2022.

Summary: Hand gesture recognition faces challenges due to variations in shape and orientation among individuals. Various methodologies, including KNearest Neighbors (KNN), Support Vector Machine (SVM), and Convolutional Neural Network (CNN), have been employed to address this issue. This paper conducts a comparative analysis of these algorithms using a dataset of 29,000 images. Results show CNN outperforms KNN and SVM, achieving 98.49% accuracy compared to 93.83% and 88.89%, respectively.

[C]Title- Sign Language Recognition Using Deep Learning On Static Gesture Images Authors: Aditya Das, Shantanu Publication Journal & Year: 2023

Summary: The image dataset used consists of static sign gestures captured on an RGB camera. Preprocessing was performed on the pictures, which then served as cleaned input.. The model consists of multiple convolution filter inputs that are processed on the identical input. The validation accuracy obtained was above 90% This paper also reviews the assorted attempts that are made at sign language detection using the ML and depth data of images. It takes stock of the varied challenges posed in tackling such an Issue, and descriptions future scope also.

[D]Title: Deep learning- based approach for sign language Recognition with efficient Hand Gesture representation.
Authors: Muneer Al - Hammadi
Publication Journal & Year:- IEEE, 2021.

Summary:- Hand gesture recognition (HGR) has emerged as a significant research area. This paper focuses on classifying single and double-handed Indian sign language gestures using machine learning algorithms implemented in MATLAB, achieving an accuracy ranging from 92% to 100%.

3. EXISTING SYSTEM

Indian sign language lags behind American due to lack of standard datasets, with varying gestures and multiple signs for the same character. Kannada Sign Language recognition lacks established deep learning techniques, but ongoing research focuses on general sign language recognition and other languages.

4. PROPOSED SYSTEM

The Kannada Sign Language (KSL) Recognition system combines machine learning and deep learning methods, utilizing TensorFlow and Media Pipe for accuracy. Extracted features feed into a TensorFlow-based deep learning model. The deep learning architecture, possibly employing convolutional neural networks (CNN) will be trained on a comprehensive dataset of Kannada sign gestures to learn and recognize intricate within the gestures. Media pipe, a powerful library for real-time hand tracking and gesture recognition, will likely facilitate the preprocessing steps by providing robust tools for hand landmark estimation and gesture analysis. The training set consists of 70% of the aggregate data and remaining 30% is for testing. We concentrate more on developing ISL along with Indian regional language, Kannada. KSL uses single hand for text recognition, provided in KSL Kannada words (ಪದಗಳು), is in under research and implementation. Implementing 2 letter,3,letter,4 letter words (ಪದಗಳು) in Kannada , We totally implement 50 words (ಪದಗಳು) and (೨, ೩, ೪ ಅಕ್ಷರಗಳು), and Try recognizing giving the 80-90% accuracy.

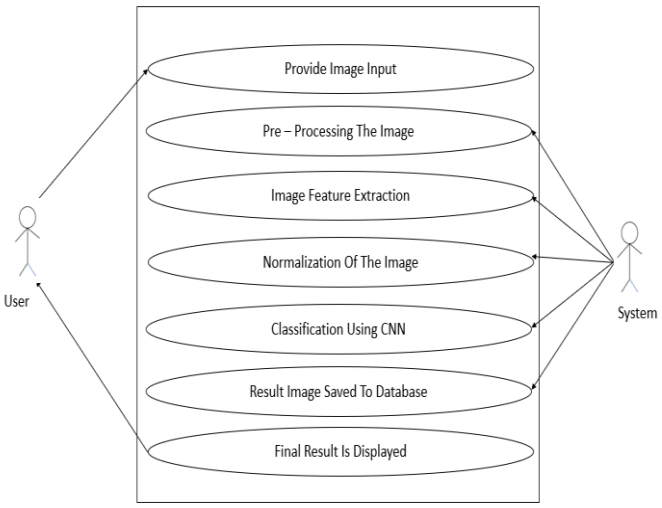

Fig. 1: Sequence Diagram

5. SYSTEM ARCHITECTURE

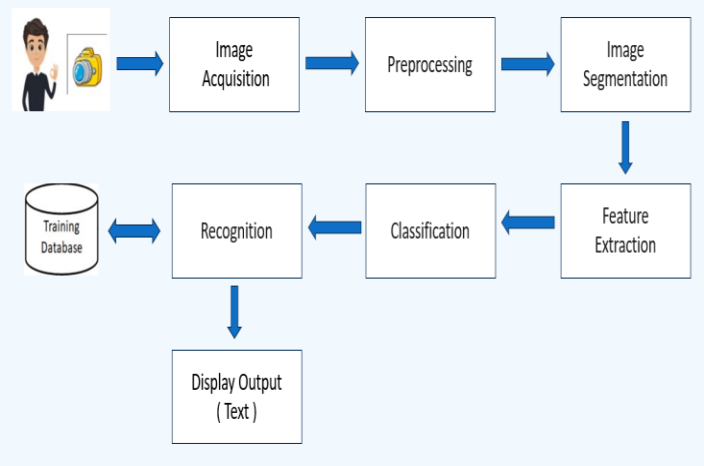

Fig. 2: Architecture Diagram

5.1 MediaPipe

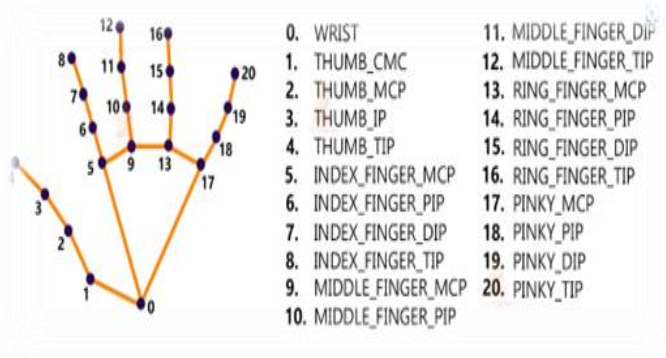

Fig. 3:21 Key-points of MediaPipe

Media Pipe integration is crucial in Kannada Sign Language Recognition, offering robust hand tracking for capturing intricate gestures. Pre-trained models accurately detect hand landmarks in real-time video, serving as key input for machine learning models. Media Pipe facilitates seamless integration with TensorFlow, enabling developers to customize tracking pipelines for optimal performance. This enhances accuracy and accessibility for individuals with hearing impairments..

5.2 TensorFlow

In the Kannada Sign Language Recognition project, TensorFlow enables the development of advanced ML models, particularly convolutional neural networks (CNN). It provides tools for designing, training, and deploying tailored neural network architectures. TensorFlow seamlessly integrates with other frameworks like Media Pipe for feature extraction, ensuring a smooth workflow from data preprocessing to model deployment. TensorFlow is fundamental to this project, empowering the accurate interpretation of sign language gestures and promoting inclusivity for individuals with hearing impairments.

5.4 CLASSIFIER

On this paper, we have applied one classifier to assess their performance with our approach. An overview of these classifiers is given below:

5.4.1 CONVOLUTIONAL NEURAL NETWORK (CNN)

Machine learning encompasses various artificial neural network models, convolutional neural networks (CNNs), specifically designed for tasks like image recognition and signal processing. CNNs, structured akin to the human brain, outperform previous networks with image and audio inputs.

CNN Layers:

- Convolutional Layer: Performs computations and identifies features by moving kernels over the image's receptive fields.

- Pooling Layer: Simplifies the network by reducing input parameters and retains essential information.

- Fully Connected (FC) Layer: Categorizes images based on extracted features, with connections between every activation unit from the preceding layer.

In CNNs, the complexity increases from the convolutional to the FC layer, enabling recognition of intricate image aspects. However, not all layers are fully connected to prevent excessive network density, computational cost, and loss increase, thus preserving output quality.

6. DATASETS

Gathering datasets for the recognition of Kannada Sign language through hand gestures from educational institutions catering to the speech and hearing impaired community can serve as a valuable endeavor. However, it's imperative to prioritize ethical considerations, such as securing appropriate consent and upholding privacy standards.
We are procuring datasets from the following institutions:
1.JSS Polytechnic For The Differently Abled, Mysuru.
2.Institute Of Speech And Hearing, Mysuru.
3.All India Institute Of Speech And Hearing, Mysuru.

Our dataset encompasses 45 Kannada words, varying in length from two to four letters, for which we are capturing hand gestures. For each word, we are recording 150 images encompassing all feasible angles, with an additional 50 images reserved for testing purposes.

Each image adheres to the following specifications:
1.Dimensions: 300 x 300 pixels.
2.File size: 25kb.

3.Resolution: 96 dpi (Dots per inch) both horizontally and vertically.

7. RESULTS

Following are the screenshots of the interface and output of the proposed system.

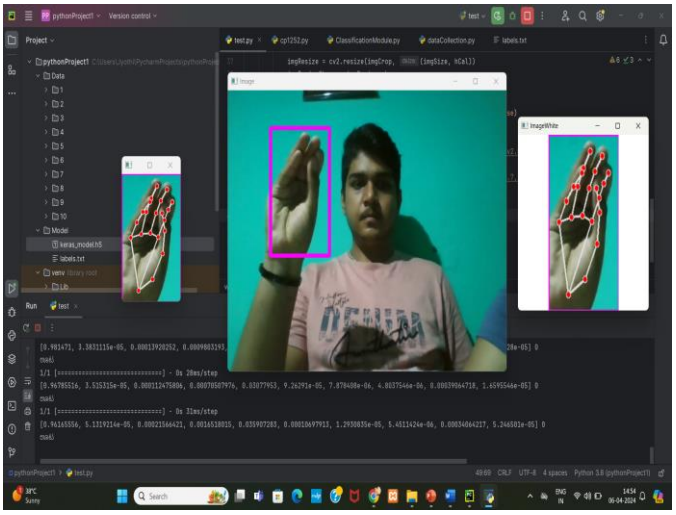

Fig. 4:Kannada Sign showing "Uta"

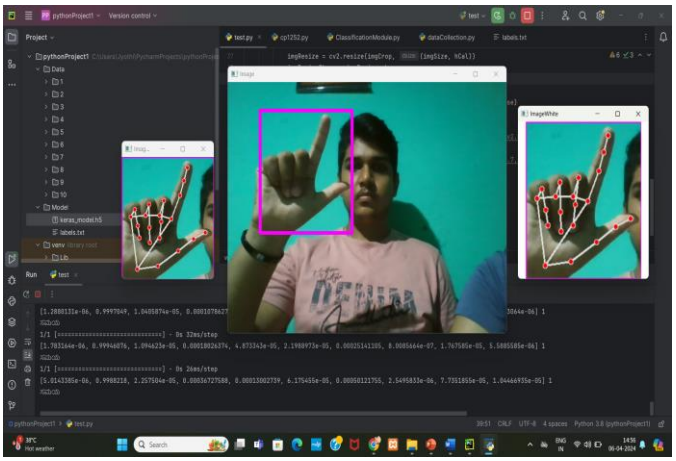

Fig. 5: Kannada Sign showing "Samya"

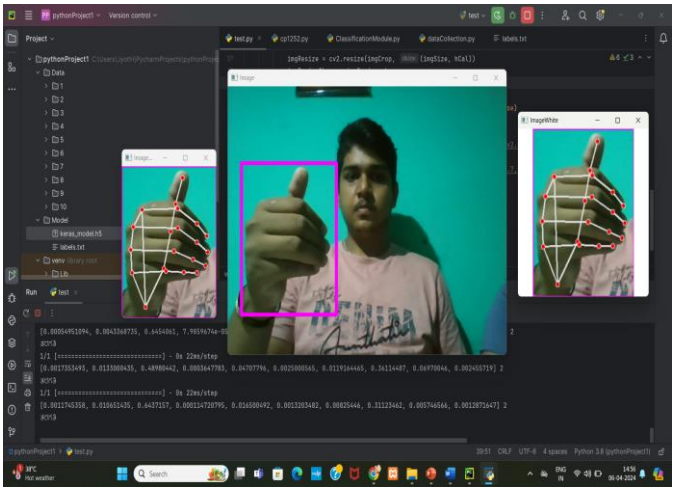

Fig. 6: Kannada Sign showing "Tharagthi"

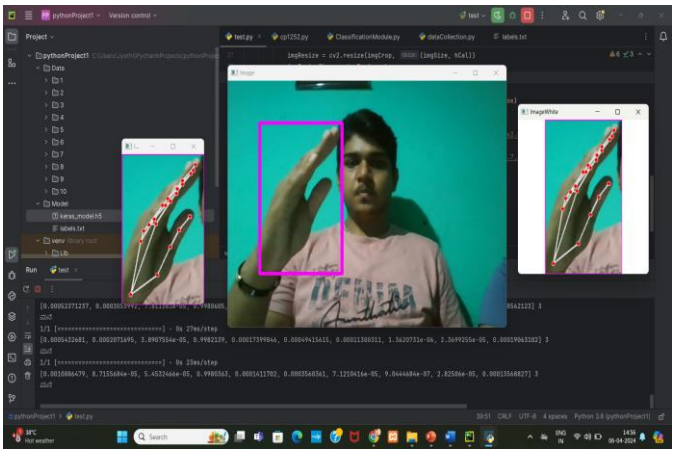

Fig. 7: Kannada Sign showing "Mane "

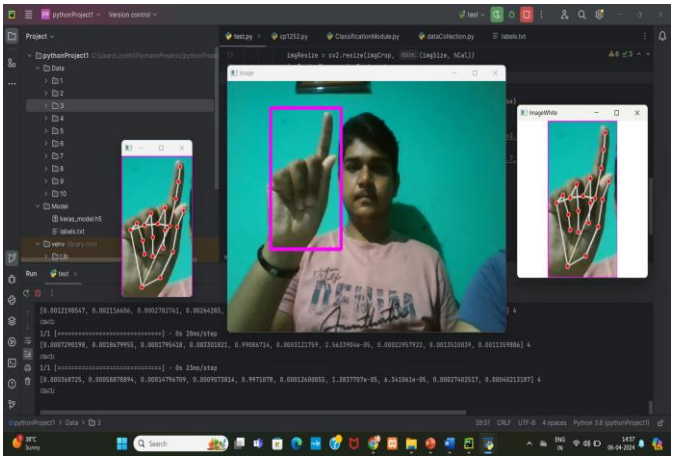

Fig. 8: Kannada Sign showing "Nanu"

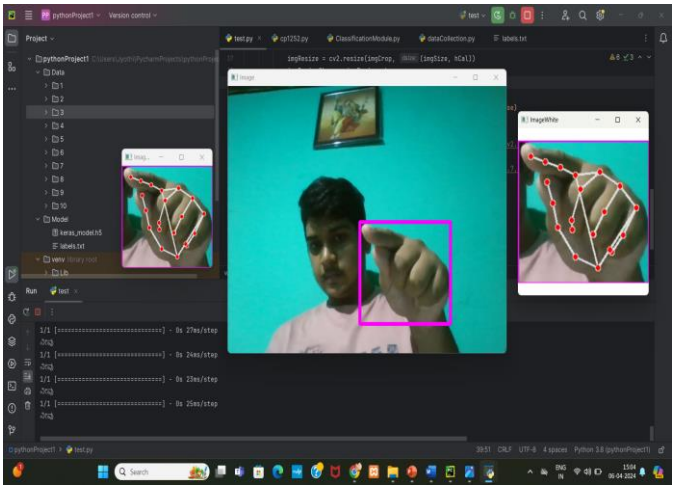

Fig.9 : Kannada Sign showing "Nenu"

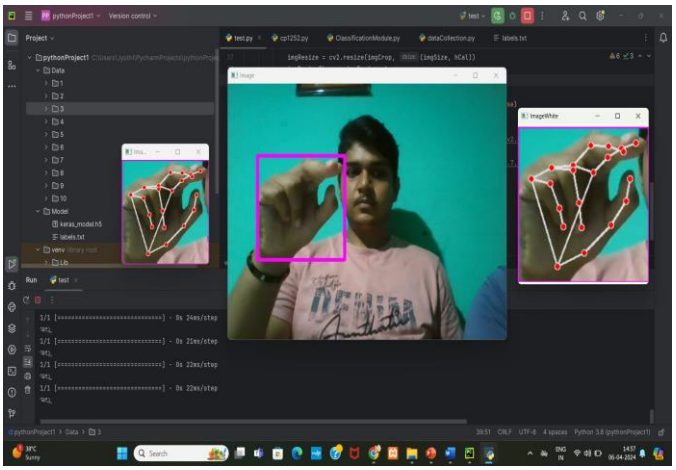

Fig. 10: Kannada Sign showing "Ella"

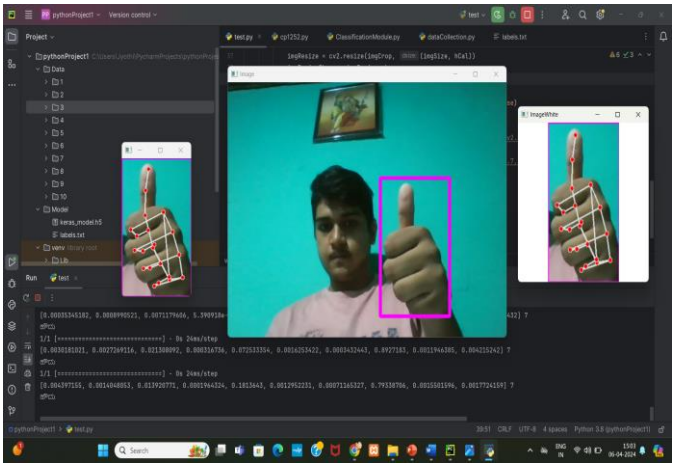

Fig. 11: Kannada Sign showing "Howdu"

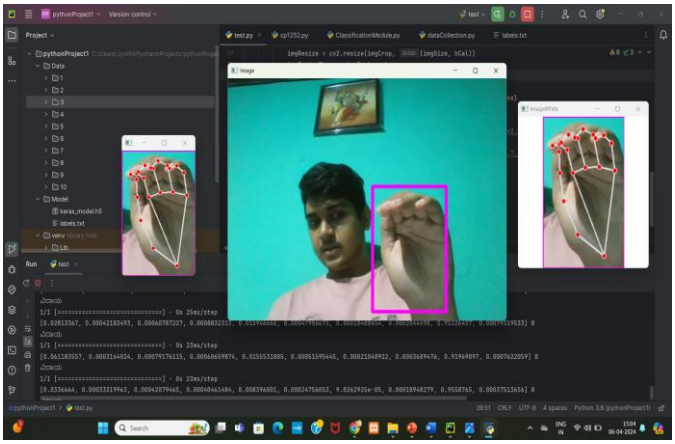

Fig. 12: Kannada Sign showing "Veedaya"

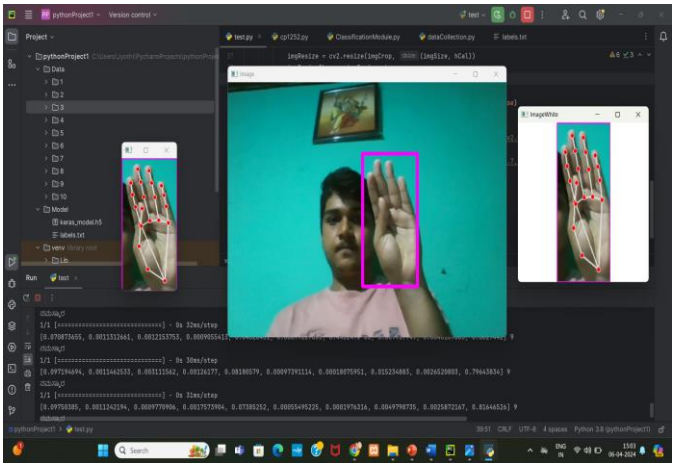

Fig. 13: Kannada Sign showing "Namaskara"

8. CONCLUSIONS

In conclusion, the development of Kannada Sign Language Recognition through Hand Gesture and machine learning, particularly utilizing convolutional neural network (CNN) classifiers, marks a significant advancement in bridging communication barriers for community. This innovative approach not only facilitates real-time interpretation of gestures but also holds the promise of enhancing accessibility to vital information and services for individuals using Kannada sign language. To enable Kannada Sign Language (KSL) word and sentence recognition, we need a it is to temporal space analysis. This will involve detecting temporal changes and motion in signs. Our goal to develop a comprehensive product to aid speech and hearing-impaired individuals, bridging communication gaps. We'll focus on converting gesture sequences into text, both words and sentences, and then synthesizing speech for auditory comprehension.

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