International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering
ISO 3297:2007 Certified ⁘ Impact Factor 8.021 ⁘ Peer-reviewed / Refereed journal ⁘ Vol. 11, Issue 8, August 2023
DOI: 10.17148/IJIREEICE.2023.11805

Sign Language Detection

Swaraj Khursade[1], Gargi Kulkarni[2], Sidhharth Khare[3], Ms. Nrupal Sankpal[4]

Student, Electronics and Telecommunications, P.E.S Modern College of Engineering, Pune, India[1,2,3]

Assistant Professor, Electronics and Telecommunications, P.E.S Modern College of Engineering, Pune, India[4]

Abstract: Sign language is a form of communication that utilizes methods to express everyday messages. Unlike sign languages, the interpretation of ISL (International Sign Language) has received attention from researchers. In this paper we present a translation system specifically designed to interpret alphabets, in English sign language. This system focuses on analysing images of hands allowing users to interact with it naturally. By eliminating the need for interpreters, it offers individuals the opportunity to communicate with deaf people seamlessly. Our goal is to develop systems and methods for recognizing and translating sign language.

The initial step of this system involves creating a database for English Sign Language. Hand segmentation plays a role in achieving accurate hand gesture recognition rates within any recognition system. By improving the quality of output, we can enhance recognition rates significantly. Furthermore, our proposed system incorporates a robust hand segmentation and tracking algorithm to achieve results in recognition accuracy. We have utilized a collection of samples to recognize 43 isolated words, from Standard English sign language.

In our proposed system we aim to recognize elements of sign language and facilitate their translation into text well as vice versa in the English language.

Keywords: Sign Language, Machine Learning, Convolutional Neural Network, Gesture Recognition.

I. INTRODUCTION

In recent times, there's been a lot of buzz around hand gesture recognition systems, especially in the context of helping those who face challenges in speaking and hearing. Think about individuals who can't use their voice to communicate – they rely on hand gestures to convey their thoughts and feelings. Unfortunately, there are people out there who might not understand these gestures or sign language. This is where a cutting-edge solution comes into play: an automated system that can interpret these gestures and make sense of their meanings. Imagine trying to have a conversation with someone who is deaf – it might seem like a daunting task, especially if you're not familiar with sign language. Now, consider the millions of deaf people who struggle daily to connect with those who can hear. This disconnect prevents them from fully participating in conversations and interactions with the hearing world. To bridge this gap, our team came up with an ingenious idea: a system that allows both deaf individuals and those who can speak to communicate using sign language.

The motivation behind this idea is simple yet powerful. When a stranger visits a deaf person, and the deaf individual is facing a problem they need to convey, the situation quickly becomes complex. Understanding the meaning of their signs can be a real challenge, and any delay in interpreting these gestures might even lead to critical issues. These are the moments when deaf individuals can't enjoy a normal, barrier-free life. The frustration of not being able to express themselves affects their personal and professional lives.

Dreams and aspirations suddenly seem limited, and feelings of demotivation and inferiority start to take hold. Our objective is clear: empower these individuals to express their thoughts and ideas freely. By doing so, we aim to boost their motivation and confidence, allowing them to think positively and overcome their physical limitations. With the latest technologies and tools at our disposal, we're committed to tackling this global problem head-on. Our proposed system isn't just a solution; it's a step toward innovation on a global scale. It has the potential to serve as a prototype and a proof of concept for addressing this widespread issue.

This system won't just benefit the deaf community; it has the potential to be adopted by anyone. Imagine a world where a deaf person can communicate through gestures in front of a camera, and those gestures are instantly translated into text or speech. It's a vision that can truly transform lives and bring people together, breaking down communication barriers that have persisted for far too long.

DOI: 10.17148/IJIREEICE.2023.11805

II. LITERATURE REVIEW

The paper "Study of Sign Language Translation using Gesture Recognition" by Neha Poddar, Shrushti Rao, Shruti Sawant, Vrushali Somavanshi, Prof. Sumita Chandak (2015) presents a system to bridge communication gaps for mute and hearing-impaired individuals. The system translates sign language gestures into text and speech, aiding interaction with those unfamiliar with sign language. The approach involves two modes: "Teach" and "Learn." In "Teach," users' webcam-generated gestures are matched to alphabet letters using a gesture database. In "Learn," text inputs are converted to sign language gestures for display. The paper outlines image capturing, gesture segmentation, and translation processes. It highlights the importance of accurate hand detection, gesture recognition, and user-friendly interfaces. Related research approaches, such as data gloves and contour recognition, are summarized, focusing on their merits and limitations. The paper concludes by noting opportunities for system enhancements, including integration with virtual reality and AI technologies. [1]

The paper "Low-cost approach for Real Time Sign Language Recognition" was presented at the 2013 IEEE 8th International Conference on Industrial and Information Systems (ICIIS). Authors Matheesha Fernando and Janaka Wijayanayaka propose an affordable method for real-time sign language recognition. Their solution uses a simple webcam and computer vision techniques to capture and interpret sign language gestures. The system's cost-effectiveness and real-time capability are highlighted, addressing communication barriers between hearing-impaired individuals and others. The paper details their approach, including image processing and pattern recognition methods, emphasizing accurate and timely gesture recognition. In summary, the paper offers an economical solution to enhance communication accessibility for the hearing-impaired using webcam-based recognition. [2]

The paper titled "A Survey on Artificial Intelligence in Chinese Sign Language Recognition" by Jiang, Xianwei & Satapathy, Suresh & Yang, Longxiang & Wang, Shui-Hua & Zhang, Yudong. (2020) focuses on the importance of Chinese Sign Language (CSL) as a means of communication for the hearing-impaired in China and the significance of Sign Language Recognition (SLR) technology in bridging the communication gap between hearing-impaired individuals and the broader society. The paper reviews various techniques and algorithms employed in CSLR research from 2000 to 2019, encompassing stages like data acquisition, preprocessing, feature extraction, and classification. The survey covers methods such as scale-invariant feature transform, histogram of oriented gradients, wavelet entropy, Hu moment invariant, Fourier descriptor, gray-level co-occurrence matrix, dynamic time warping, principal component analysis, autoencoders, hidden Markov models (HMM), support vector machines (SVM), random forests, skin color modeling, k-nearest neighbors (k-NN), artificial neural networks, convolutional neural networks (CNN), and transfer learning. [3]

The paper titled "A System for Recognition of Indian Sign Language for Deaf People using Otsu’s Algorithm" presents a system designed to recognize Indian Sign Language (ISL) gestures for the benefit of deaf individuals. The authors are identified as Ms. Manisha D. Raut, Ms. Pallavi Dhok, Mr. Ketan Machhale, and Ms. Jaspreet Manjeet Hora. The research is published in the International Research Journal of Engineering and Technology (IRJET). The focus of the paper is on the development of a system that can effectively recognize ISL gestures. The Otsu's algorithm is employed as a key component in this recognition process. Otsu's algorithm is a method used for automatic thresholding in image processing, particularly in situations where the separation between two classes of pixels is sought. The primary objective of the system is to facilitate communication for the deaf population by recognizing their sign language gestures. This technology could potentially bridge the communication gap between the deaf community and others who may not be familiar with ISL. [4]

III. METHODOLOGY

The methodology employed in the "Sign Language Detection" project encompasses a series of well-defined steps aimed at creating a robust and effective system for recognizing and interpreting sign language gestures.

Each step plays a crucial role in building a functional system that addresses the communication needs of the hearing-impaired community:

1. **Training Dataset: Building the Foundation**
The foundation of the project is laid with the creation of a comprehensive training dataset. This dataset comprises a diverse collection of images or video frames, each capturing distinct sign language gestures. Each gesture is meticulously labelled, associating it with its corresponding meaning. This dataset becomes the initial material used to train machine learning models, enabling them to understand the unique features and patterns inherent in various gestures.

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526
International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering
ISO 3297:2007 Certified ⁒ Impact Factor 8.021 ⁒ Peer-reviewed / Refereed journal ⁒ Vol. 11, Issue 8, August 2023
DOI: 10.17148/IJIREEICE.2023.11805

2. **Data Preprocessing: Refining for Accuracy**
Raw data from diverse sources often requires preprocessing to ensure its quality and consistency. In the context of the project, data preprocessing techniques come into play to clean, enhance, and standardize the input data. Processes such as noise reduction, resizing, and normalization are applied to the captured images or video frames. This step ensures that the input data is optimal for subsequent analysis and interpretation.

3. **Image/Video Acquisition: Gathering Visual Input**
The project's workflow commences with the acquisition of visual input, i.e., capturing images or frames from external sources. These sources may include cameras or video streams. These visual inputs serve as the raw material that the system analyses and processes to recognize and interpret sign language gestures. The quality and clarity of the captured images play a pivotal role in the accuracy of the system's predictions.

4. **User Interface (UI) and Database Integration: Interaction and Storage**
The development of a user interface (UI) using Python is a critical component of the project. This UI provides a platform for users to interact with the system. Users can provide new sign language gestures through the UI, which captures these gestures as images or video frames. Simultaneously, user credentials are collected and stored in a database. The database integration, often utilizing technologies like SQLite, ensures efficient management of user data for future reference.

5. **Classification: Recognizing Gestures**
At the core of the project lies the classification of sign language gestures. For images, the classification module leverages the "bag of visual words" technique. This involves clustering the feature descriptors extracted from images, creating a vocabulary of visual words. Each image is then represented by a histogram of these visual words, facilitating the machine learning model's recognition process. When it comes to video, each frame is treated as an individual image, and the classification procedure is extended similarly.

In summary, the methodology employed in the "Sign Language Detection" project systematically guides the development of a sophisticated system for interpreting sign language gestures. By creating a comprehensive training dataset, refining data through preprocessing, capturing visual input, building a user-friendly interface, and employing classification techniques, the project succeeds in breaking down communication barriers. The system's ability to recognize and interpret sign gestures fosters inclusivity and communication accessibility for the hearing-impaired community, showcasing the impactful potential of technology in bridging gaps and enhancing lives.

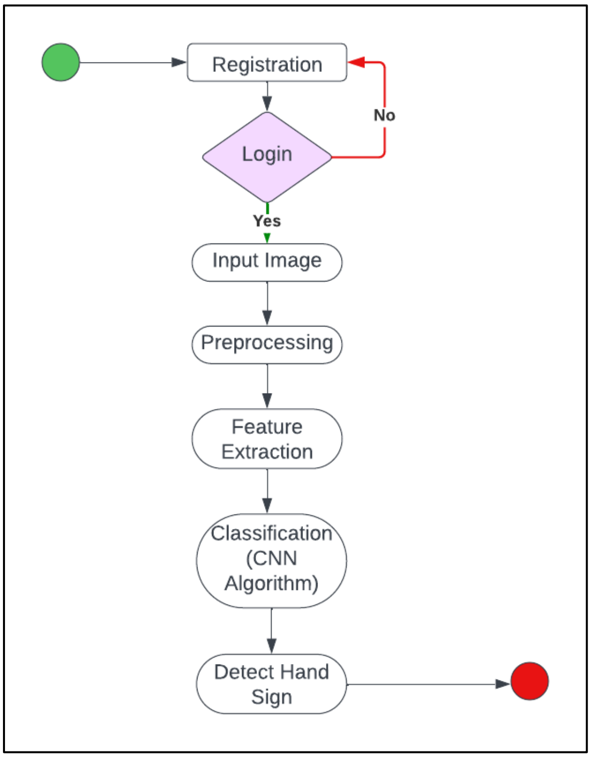

Figure 1: Flow Chart

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526
International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering
ISO 3297:2007 Certified ⁜ Impact Factor 8.021 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 11, Issue 8, August 2023
DOI: 10.17148/IJIREEICE.2023.11805

Here is a description of the flowchart:

- Registration:

Users start by registering for the system. They provide their details and create a unique account.

- Login (Yes or No):

Users can log in using their registered credentials. If they're new users, they go through the registration process.

- Input Image:

After logging in, users can provide an image of the hand gesture they want to communicate.

- Preprocessing:

The input image goes through preprocessing steps to enhance its quality and remove noise. This might involve resizing, filtering, and normalization.

- Feature Extraction:

From the pre-processed image, relevant features are extracted. These could include edge information, texture patterns, and key points.

- Classification (CNN Algorithm):

The extracted features are then fed into a Convolutional Neural Network (CNN) algorithm. The CNN is trained on a dataset of various hand gestures and their corresponding meanings. It learns to recognize patterns and relationships within the features.

- Hand Sign Detection:

The CNN algorithm outputs a prediction based on the learned patterns. This prediction corresponds to the detected hand gesture's meaning.

- Communication:

The system converts the detected gesture's meaning into text or speech, depending on the user's preference.

- Output Display:

The converted text or speech is displayed on the user's screen. This allows both deaf and hearing individuals to understand the communicated message.

IV. RESULTS

The presented visuals demonstrate the outcomes achieved by the sign language detection system. This sophisticated system incorporates a diverse array of functionalities and critical insights, providing users with accurate sign gesture recognition and efficient performance. In the subsequent sections, a comprehensive overview of the attained results is provided, complemented by accompanying screenshots that vividly illustrate the integrated interface elements within the system.

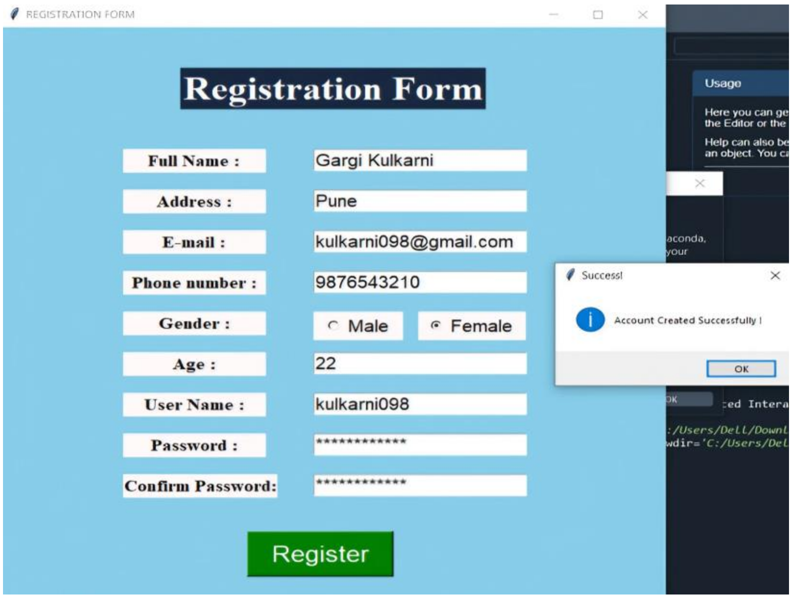

Figure 2: Registration form

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.021 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 11, Issue 8, August 2023

DOI: 10.17148/IJIREEICE.2023.11805

Registration Form:

The registration form serves as the gateway for new users to join our system, creating a personalized profile that enhances their experience. With user-friendliness at its core, the form is designed to gather essential personal information while ensuring a seamless and secure registration process. The form is thoughtfully organized into distinct tabs, making it easy for users to navigate and provide their details. Within each tab, users are prompted to enter key information, including their name, mobile number, address, email address, age, gender, password, and a confirm password. These fields collectively enable us to tailor the user experience and ensure the security of their account. The "Email" field ensures streamlined communication, while the "Age" and "Gender" fields help personalize the system's interactions. The "Password" and "Confirm Password" fields guarantee the safety and privacy of users' accounts, with password confirmation serving as an extra layer of security.

With this well-structured registration form, our aim is to create a user-centric experience that not only simplifies the onboarding process but also fosters a sense of trust and security for every new user entering our system.

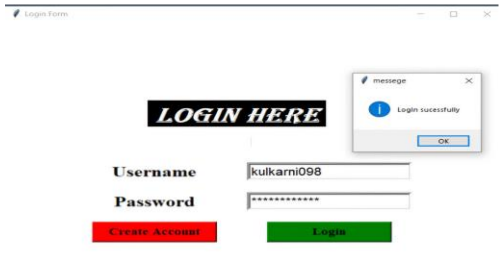

Figure 3: Login Page

User Login and System Access:

The result page begins by detailing the successful user login process. Users were able to access the system by providing their credentials through the user interface (UI). The UI, developed using Python, facilitated user authentication, ensuring that only authorized users could proceed. Upon entering valid login credentials, users gained access to the system's functionalities.

Figure 4: Results

Results:

Upon thorough analysis, the CNN algorithm reaches a conclusion regarding the nature of the sign gesture being performed. This conclusion is encapsulated in an output that typically takes the form of a label or class. This label serves as a symbolic representation of the recognized sign gesture, effectively translating the visual input into a textual representation.

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering
ISO 3297:2007 Certified ⁝ Impact Factor 8.021 ⁝ Peer-reviewed / Refereed journal ⁝ Vol. 11, Issue 8, August 2023
DOI: 10.17148/IJIREEICE.2023.11805

For instance, consider the scenario where the input image represents the hand gesture for the letter "B" in American Sign Language (ASL). The CNN algorithm's output would precisely correspond to the class label "B," thus succinctly encapsulating the essence of the interpreted gesture.

V. CONCLUSION

The paper "Sign Language Detection" focused on creating an automated system to recognize and interpret sign language gestures for the deaf community. Developed by Swaraj Khursade, Gargi Kulkarni, and Sidhharth Khare, with guidance from Ms. Nrupal Sankpal, the project aimed to enable natural interaction through images of hand gestures, bridging the communication gap between the hearing-impaired and non-deaf individuals. The system utilized Python, convolutional neural networks (CNN), and SQLite for database management. It offered user-friendly interfaces for registration, login, and gesture recognition output. The project highlighted the potential of recognizing sign language gestures and converting them into text or speech, fostering inclusion and communication. The report suggests future enhancements, including expanding compatibility, recognizing more signs, and optimizing for mobile devices. The project serves as a technological step toward addressing communication challenges faced by the hearing-impaired community.

REFERENCES

[1]. Poddar, N., Rao, S.R., Sawant, S., Somavanshi, V., & Chandak, S. (2015). Study of Sign Language Translation using Gesture Recognition. International Journal of Advanced Research in Computer and Communication Engineering, 264-267.
[2]. J. R. Pansare and M. Ingle, "Vision-based approach for American Sign Language recognition using Edge Orientation Histogram," 2016 International Conference on Image, Vision and Computing (ICIVC), Portsmouth, UK, 2016, pp. 86-90, doi: 10.1109/ICIVC.2016.7571278.
[3]. Arslan Arif, Syed Tahir Hussain Rizvi, Iqra Jawaid, Muhammad Adam Waleed, TechnoTalk: An American Sign Language (ASL) Translator, at CoDIT'16 - April 6-8, 2016, Malta.
[4]. Justin K. Chen, Debabrata Sengupta, Rukmani Ravi Sundaram Vaishali. S. Kulkarni et al., "Sign Language Gesture Recognition with Unsupervised Feature Learning", (IJCSE) International Journal on Computer Science and Engineering [Vol. 02, No. 03,560-565] ,2010.
[5]. M. Fernando and J. Wijayanayaka, "Low-cost approach for real time sign language recognition," 2013 IEEE 8th International Conference on Industrial and Information Systems, Peradeniya, Sri Lanka, 2013, pp. 637-642, doi: 10.1109/ICIInfS.2013.6732059.
[6]. P. Chavan, T. Ghorpade and P. Padiya, "Indian sign language to forecast text using leap motion sensor and RF classifier," 2016 Symposium on Colossal Data Analysis and Networking (CDAN), Indore, India, 2016, pp. 1-5, doi: 10.1109/CDAN.2016.7570936.
[7]. Ms. Manisha D. Raut, Ms. Pallavi Dhok, Mr. Ketan Machhale, Ms. Jaspreet Manjeet Hora, "A System for Recognition of Indian Sign Language for Deaf People using Otsu's Algorithm", International Research Journal of Engineering and Technology (IRJET).

