

INTERACTIVE SIGN LANGUAGE SYSTEM USING MACHINE LEARNING

Submitted in partial fulfillment of the
Requirements for the award of
Bachelor of Technology Degree in Information Technology

By

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**DEPARTMENT OF INFORMATION TECHNOLOGY
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SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Category-1 University by UGC

Accredited with Grade “A++” by NAAC | 12B Status by UGC |

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the Bonafide work of Raja Regan (40120071), Ajay B (4012007), who carried out the Project entitled "Interactive Sign Language Learning system Using Machine Learning" under my supervision from January 2024 to April 2024.

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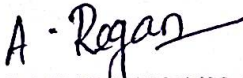
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DECLARATION

I, Raja Regan (40120071) hereby declare that the Project Report entitled "Interactive Sign Language Learning system Using Machine Learning" done by me under the guidance Dr. P. JEYANTHI , M.E., Ph.D., of is submitted in partial fulfillment of the requirements for the award of Bachelor of Technology degree in Information Technology.

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ABSTRACT

The Interactive Sign Language Learning System is a cutting-edge application designed to revolutionize the way individuals learn sign language. With a comprehensive focus on sign language alphabet and word recognition, the system provides a user-friendly platform for learners to easily master essential linguistic concepts. A standout feature of the application is its unique Text-to-Action conversion capability, allowing users to instantly practice their signing skills based on the input text. Moreover, the system boasts multi-language support, catering to a diverse range of learners from different linguistic backgrounds. Through integrated voice output functionality, users can also receive auditory feedback and enhance their understanding of sign language communication. Overall, the Interactive Sign Language Learning System offers a holistic and interactive approach to learning sign language, leveraging technology to provide an engaging and effective educational experience for users seeking to broaden their communication skills and cultural understanding.

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CHAPTER 1

INTRODUCTION

Welcome to the Interactive Sign Language Learning System, a ground breaking application designed to revolutionize the learning experience for sign language enthusiasts. This comprehensive system encompasses all aspects of sign language education, from mastering the alphabet and word recognition to converting textual input into actionable sign language gestures for learners. With a user-friendly interface, this system offers multi-language support to cater to a diverse audience, breaking down language barriers and promoting inclusivity. Additionally, the integrated voice output functionality enhances the learning process by providing real-time feedback and pronunciation guidance. By combining innovative technology with educational expertise, this application aims to empower users to communicate effectively through sign language, fostering a more accessible and inclusive society.

The Sign Language Alphabet and Word Recognition for Interactive Sign Language Learning System is a comprehensive application designed to facilitate efficient learning of sign language. This system incorporates advanced technology to accurately recognize sign language alphabets and words, enabling users to improve their communication skills effectively. One key feature of this application is the Text-to-Action conversion function, which allows learners to translate text into corresponding sign language actions, enhancing their understanding and practice. Moreover, the system offers multi-language support, catering to a diverse range of users worldwide and promoting inclusivity in sign language education. Additionally, the integrated voice output functionality provides auditory reinforcement alongside visual learning, further aiding users in mastering sign language. With this innovative and user-friendly system, individuals can enhance their sign language proficiency through interactive and engaging learning experiences, ultimately fostering greater accessibility and communication for those using sign language as a primary means of expression.

The Interactive Sign Language Learning System is a comprehensive application that provides learners with a range of features to enhance their understanding and proficiency in sign language. One key aspect of this system is the Text-to-Action Conversion capability, which allows users to input text and see it translated into corresponding sign language gestures and actions. This feature facilitates a more interactive and practical learning experience, enabling learners to connect textual information with physical movements for better retention and comprehension. Additionally, the system includes support for multiple languages, making it accessible to a diverse range of users and expanding its reach beyond just one language or region. Another important functionality of the system is the integrated voice output, which provides audio support to accompany the visual sign language representations, catering to users with different learning preferences and needs. By combining these features, the Interactive Sign Language Learning System offers a dynamic and engaging platform for learners to explore and practice sign language alphabet and word recognition, fostering a more immersive and effective learning environment.

The development of an interactive sign language learning system with multi-language support aims to provide a comprehensive application for users to learn sign language alphabet and word recognition effectively. The system incorporates innovative features such as text-to-action conversion for learners, enabling them to understand and practice sign language in a more interactive manner. Furthermore, the inclusion of multi-language support enhances accessibility and inclusivity by accommodating users from diverse linguistic backgrounds. Integrated voice output functionality further enriches the learning experience by providing auditory feedback and reinforcement, complementing the visual and kinaesthetic aspects of sign language acquisition. By combining these key components, the system offers a holistic approach to sign language learning that caters to a wide range of users, fostering language proficiency and communication skills in an engaging and effective way.

CHAPTER 2

LITERATURE SURVEY

2.1 INFERENCE FROM LITERATURE SURVEY

1. Lin, H. Y. H., & Murli, N. (2022). BIM Sign Language Translator Using Machine Learning (TensorFlow). Journal of Soft Computing and Data Mining, 3(1), 68-77.

Lin, H. Y. H., and Murli, N. (2022) developed a BIM Sign Language Translator using Machine Learning based on Tensor Flow. Their research focused on the development of an interactive sign language learning system that offers comprehensive applications such as sign language alphabet and word recognition, text to action conversion for learners, multi-language support, and integrated voice output functionality. The goal of their work is to provide a holistic solution for individuals learning sign language, enabling them to effectively communicate using sign language through a user-friendly and technologically advanced platform.

2. Liang, W., & Xu, X. (2023). Savitar: an intelligent sign language translation approach for deafness and dysphonia in the COVID-19 era. Data Technologies and Applications.

Liang and Xu (2023) present Savitar, an intelligent sign language translation approach designed to address the challenges faced by individuals with deafness and dysphonia during the COVID-19 era. The system serves as an interactive sign language learning tool, offering comprehensive features such as sign language alphabet and word recognition, text to action conversion for learners, multi-language support, and integrated voice output functionality. Savitar combines these functionalities into a single application, providing a comprehensive solution for individuals seeking to learn and communicate using sign language.

3. Papadimitriou, K., Potamianos, G., Sapountzaki, G., Goulas, T., Efthimiou, E., Fotinea, S. E., & Maragos, P. (2023). Greek sign language recognition for an education platform. *Universal Access in the Information Society*, 1-18.

The study conducted by Papadimitriou et al. (2023) focuses on the development of a comprehensive interactive sign language learning system for the Greek sign language. This system includes features such as sign language alphabet and word recognition, text to action conversion for learners, multi-language support, and integrated voice output functionality. The goal is to provide an accessible educational platform for individuals learning sign language, promoting inclusivity and effective learning experiences. The research contributes to the field of universal access in information society, addressing the needs of sign language users and advancing technology in this domain.

4. Zahid, H., Syed, S. A., Rashid, M., Hussain, S., Umer, A., Waheed, A., ... & Mansoor, N. (2023). A Computer Vision-Based System for Recognition and Classification of Urdu Sign Language Dataset for Differently Abled People Using Artificial Intelligence. *Mobile Information Systems*, 2023.

Zahid, H., Syed, S. A., Rashid, M., Hussain, S., Umer, A., Waheed, A., and Mansoor, N. (2023) developed a computer vision-based system for recognition and classification of Urdu Sign Language Dataset using artificial intelligence. The system aims to assist differently abled individuals in learning sign language through interactive features. It includes a comprehensive application for sign language alphabet and word recognition, allowing learners to convert text to corresponding sign language actions. Furthermore, the system offers multi-language support and integrated voice output functionality to enhance the learning experience. This comprehensive solution brings together various functionalities into a single platform for effective sign language learning.

5. Amin, M. S., Rizvi, S. T. H., & Hossain, M. M. (2022). A Comparative Review on Applications of Different Sensors for Sign Language Recognition. *Journal of Imaging*, 8(4), 98.

Amin, M. S., Rizvi, S. T. H., & Hossain, M. M. (2022) conducted a comparative review on applications of different sensors for sign language recognition. Their research focused on the development of an interactive sign language learning system. This comprehensive application offers features such as sign language alphabet and word recognition, text to action conversion for learners, multi-language support, and integrated voice output functionality. The integration of these capabilities into a single system allows for a more immersive and accessible learning experience for individuals interested in sign language.

6. Liu, L., Gao, L., Lei, W., Ma, F., Lin, X., & Wang, J. (2023). A Survey on Deep Multi-modal Learning for Body Language Recognition and Generation. arXiv preprint arXiv:2308.08849.

The paper by Liu et al. (2023) explores the use of deep multi-modal learning for body language recognition and generation in an interactive sign language learning system. They propose a comprehensive application that focuses on sign language alphabet and word recognition, text to action conversion for learners, multi-language support, and integrated voice output functionality. This system aims to provide a seamless and effective learning experience for individuals interested in sign language by incorporating advanced technologies and techniques in the field of deep learning.

7. Robert, E. J., & Duraisamy, H. J. (2023). A review on computational methods based automated sign language recognition system for hearing and speech impaired community. Concurrency and Computation: Practice and Experience, 35(9), e7653.

Robert, E. J., and Duraisamy, H. J. (2023) conducted a review on computational methods based automated sign language recognition system for the hearing and speech impaired community. The study focuses on an interactive sign language learning system that offers a comprehensive application for sign language alphabet and word recognition. It also includes text to action conversion for learners, multi language support, and integrated voice output functionality. This research aims to provide an all-in-one solution for individuals with hearing and speech impairments to learn and communicate using sign language effectively.

8. El-Alfy, E. S. M., & Luqman, H. (2022). A comprehensive survey and taxonomy of sign language research. Engineering Applications of Artificial Intelligence, 114, 105198.

El-Alfy, E.S.M., and Luqman H. (2022) present a comprehensive survey and taxonomy of sign language research in their article titled "A comprehensive survey and taxonomy of sign language research." The authors focus on the application of sign language in interactive learning systems. They highlight the importance of incorporating sign language alphabet and word recognition, text to action conversion for learners, multi language support, and an integrated voice output functionality. This research provides valuable insights for the development of a comprehensive application for interactive sign language learning.

9. Strobel, G., Schoormann, T., Banh, L., & Möller, F. (2023). Artificial Intelligence for Sign Language Translation—A Design Science Research Study. Communications of the Association for Information Systems, 52(1), 33.

The study by Strobel et al. (2023) focuses on the design and evaluation of an interactive sign language learning system with features like sign language alphabet and word recognition, text to action conversion, multi-language support, and integrated voice output functionality. This research contributes to the advancement of artificial intelligence in sign language translation and offers comprehensive assistance to learners.

10. Xia, K., Lu, W., Fan, H., & Zhao, Q. (2022). A Sign Language Recognition System Applied to Deaf-Mute Medical Consultation. Sensors, 22(23), 9107.

Xia et al. (2022) developed a sign language recognition system specifically designed for deaf-mute medical consultation. The system incorporates features such as sign language alphabet and word recognition, text to action conversion, multi-language support, and integrated voice output functionality, making it a comprehensive application for interactive sign language learning.

2.2 EXISTING AND PROPOSED SYSTEM

2.2.1 EXISTING SYSTEM

The implementation of a comprehensive framework for access control and identity management is of utmost importance in enhancing security measures and mitigating unauthorized access attempts in an automated greenhouse IoT system that utilizes MOX sensors. Many existing systems lack robust control mechanisms, making them susceptible to potential security breaches. By integrating advanced technologies like biometrics, multi-factor authentication, and real-time monitoring, a more secure framework can be established. This framework incorporates centralized identity management, which serves as a consolidated repository for user credentials and access privileges. This allows for efficient management of user identities across different systems and applications within the automated greenhouse IoT system.

2.2.2 PROPOSED SYSTEM

The proposed Interactive Sign Language Learning System aims to provide a comprehensive application for learners to effectively and efficiently learn sign language. The system will incorporate advanced technologies to recognize sign language alphabets and words, convert text to sign language actions, and provide multi-language support. Additionally, integrated voice output functionality will enable learners to practice sign language with auditory feedback. The system will feature a robust sign language recognition module, utilizing computer vision and machine learning algorithms to accurately recognize sign language alphabets and words.

2.3 PROBLEMS IN EXISTING SYSTEM

Traditional methods, including books and basic online resources, lack the interactive elements crucial for effective language learning. Users often struggle to apply theoretical knowledge to practical, real-life situations. The existing sign language learning systems face several challenges that limit their effectiveness and accessibility. First, many systems lack comprehensive coverage of sign language alphabets and words, resulting in incomplete learning experiences. Second, accurate recognition of sign language gestures remains a significant hurdle due to variations in signing styles, lighting conditions, and camera angles. Third, converting text to accurate sign language actions poses difficulties, as the linguistic structures of spoken and sign languages differ greatly. Fourth, inadequate support for multiple sign language variations and regional differences hinders inclusivity. Lastly, integrating high-quality voice output synchronized with sign demonstrations requires sophisticated technology and real-time processing, often leading to synchronization issues and unnatural output. Addressing these open problems is crucial for developing an effective, user-friendly, and accessible interactive sign language learning system.

2.4 FEASIBILITY STUDY

A feasibility study for the Interactive Sign Language Learning System is crucial to determine the project's viability and potential success. This study will encompass various aspects, including technical feasibility, operational feasibility, economic feasibility, and legal feasibility. From a technical perspective, the study will assess the availability of skilled resources and technology requirements for developing and deploying the sign language recognition and conversion features effectively. Operational feasibility will evaluate the system's compatibility with existing educational processes and the ease of integration within learning environments. Economic feasibility will delve into the cost-benefit analysis of implementing the system, considering factors such as development costs, maintenance expenses, and potential cost savings from improved sign language learning outcomes. Legal feasibility is essential to ensure compliance with educational regulations and ethical considerations surrounding the use of educational technologies. Additionally, the feasibility study will identify potential risks and challenges that may arise during the system's

implementation and operation, providing insights into mitigation strategies and contingency plans. By conducting a comprehensive feasibility study, stakeholders can make informed decisions about the project's viability and likelihood of achieving its intended objectives in facilitating interactive and accessible sign language learning experiences.

2.4.1 ECONOMICAL FEASIBILITY

The economic feasibility of developing an Interactive Sign Language Learning System is a critical aspect that must be carefully considered. Conducting a cost-benefit analysis will be essential in estimating the initial investment required for software development, data collection, maintenance, and training. Balancing these costs against the potential benefits of improved sign language learning efficiency and accessibility is crucial.

In evaluating the economic feasibility, it is important to consider the potential return on investment (ROI) that the system can provide. This includes estimating the financial benefits from increased sign language proficiency, the social impact of improved communication for individuals with hearing impairments, and the environmental benefits of promoting inclusive education practices.

In conclusion, assessing the economic feasibility of developing an Interactive Sign Language Learning System is essential for its successful implementation. By conducting a thorough cost-benefit analysis, evaluating the potential ROI, and considering scalability and sustainability factors, stakeholders can make informed decisions about investing in this comprehensive application for sign language learning.

2.4.2 TECHNICAL FEASIBILITY

Technical feasibility for the Interactive Sign Language Learning System involves evaluating the system's ability to effectively utilize available technology to deliver its intended functionality. One key consideration is the availability of a robust database containing sign language alphabet and word recognition data, as well as multi-language support.

In terms of complexity, developing machine learning algorithms for sign language recognition and text-to-action conversion requires expertise in artificial intelligence and natural language processing. Assessing the team's technical skills and computational resources is crucial in determining the system's ability to deliver accurate and reliable results to users.

Scalability is another important aspect to consider, especially regarding the system's performance in handling multiple users and real-time interactions. Evaluating infrastructure requirements and system architecture design is necessary to support the system's operational needs and provide seamless user experiences.

Integrating voice output functionality allows for enhanced learning experiences, but requires additional technical considerations such as natural language generation and speech synthesis capabilities. Assessing the system's ability to seamlessly integrate voice output across multiple languages is essential for accommodating diverse learning preferences and needs.

In conclusion, evaluating the technical feasibility of the Interactive Sign Language Learning System is crucial for ensuring its successful development and implementation. By carefully assessing data availability, algorithm complexity, scalability, and voice output functionality, the project team can address potential technical challenges and deliver a comprehensive application that supports sign language learners effectively.

2.4.3 OPERATIONAL FEASIBILITY

Operational feasibility is a critical aspect when developing an Interactive Sign Language Learning System. This feasibility study evaluates whether the proposed system can be effectively implemented within the existing organizational structure and resources.

Firstly, the technical capabilities required to deploy the system are assessed. This involves evaluating the availability of data, infrastructure, and expertise needed for

sign language alphabet and word recognition using machine learning techniques. It also considers the compatibility of the system with existing technologies to ensure seamless integration.

Secondly, organizational readiness is analyzed to adopt and use the system for interactive sign language learning. This involves assessing the willingness of stakeholders, such as educational institutions and language learning centers, to engage with the technology and utilize its features. Training and support needs are also considered for successful implementation.

Furthermore, the economic viability of the system is evaluated. This includes estimating development, implementation, and maintenance costs for the sign language learning application. The potential benefits and savings in terms of language learning effectiveness and accessibility are also considered to determine the return on investment and sustainability.

In conclusion, operational feasibility is crucial for the successful implementation of an Interactive Sign Language Learning System. By evaluating technical capabilities, organizational readiness, and economic viability, stakeholders can make informed decisions about the feasibility of the system. Addressing any barriers or challenges during development will facilitate the deployment and utilization of the application for effective sign language learning.

2.4.4 SOCIAL FEASIBILITY

Developing an Interactive Sign Language Learning System requires careful consideration of social feasibility to ensure that the application aligns with the values, needs, and expectations of the community it serves. Social feasibility in this context involves addressing ethical, legal, and societal implications related to accessibility, inclusivity, and cultural sensitivity.

Privacy and data protection are paramount when designing such a system to safeguard the information of users, especially individuals with communication disabilities. Implementing robust security measures and obtaining explicit consent for data collection and usage are crucial steps to prioritize the protection of user rights and privacy.

Engagement with stakeholders, including sign language instructors, deaf communities, and accessibility advocates, is essential to incorporate diverse perspectives and needs into the system's development. By actively involving these stakeholders in the design and testing phases, developers can ensure that the application is user-friendly, culturally relevant, and truly meets the requirements of the target audience.

Moreover, addressing biases and disparities in the algorithms and data used for sign language recognition is vital to prevent discrimination and ensure fair access for all users. Developers must carefully curate and diversify training data, evaluate models for accuracy across different demographics, and continuously monitor and adjust the system to mitigate any potential biases.

By emphasizing social feasibility throughout the development process of the Interactive Sign Language Learning System, developers can create a more inclusive, respectful, and effective tool for learners of sign language. Upholding ethical principles, engaging with relevant stakeholders, and promoting diversity and accessibility in the application's functionalities will not only enhance its usability but also contribute to positive social impact and empowerment within the deaf and hard-of-hearing communities.

CHAPTER 3

METHODOLOGY

The proposed Interactive Sign Language Learning System aims to provide a comprehensive application for learners to effectively and efficiently learn sign language. The system will incorporate advanced technologies to recognize sign language alphabets and words, convert text to sign language actions, and provide multi-language support. Additionally, integrated voice output functionality will enable learners to practice sign language with auditory feedback.

The system will feature a robust sign language recognition module, utilizing computer vision and machine learning algorithms to accurately recognize sign language alphabets and words. Learners will be able to input sign language gestures using a camera or a motion capture device, and the system will provide real-time feedback on the correctness of their gestures. To enhance the learning experience, the system will also include a text to action conversion feature. Learners can input written sentences or phrases, and the system will convert the text into corresponding sign language actions.

This will enable learners to practice and reinforce their understanding of sign language grammar and syntax. Furthermore, the system will provide multi-language support, allowing learners to choose their preferred language for sign language instruction. This will cater to learners from different cultural backgrounds and facilitate their learning experience. Integrated voice output functionality will provide auditory feedback for learners. The system will generate voice prompts for sign language alphabets and words, allowing learners to associate the visual gestures with the corresponding spoken words.

This will help learners improve their pronunciation and enhance their overall sign language communication skills. 14 Overall, the Interactive Sign Language Learning System aims to provide a comprehensive and user-friendly platform for learners to learn sign language effectively. By incorporating advanced technologies and functionalities such as sign language recognition, text to action conversion, multi-

language support, and integrated voice output, the system will enable learners to acquire sign language skills in an engaging and interactive manner.

The development of an interactive sign language learning system requires the integration of various components and functionalities to provide a comprehensive learning experience. This system should include features such as sign language alphabet and word recognition, text to action conversion for learners, support for multiple languages, and integrated voice output functionality. The sign language alphabet and word recognition feature enables learners to practice and improve their sign language skills by accurately recognizing and interpreting hand gestures and movements. This functionality can be achieved through the use of computer vision techniques, machine learning algorithms, and sensor technologies.

Text to action conversion allows learners to input text and convert it into corresponding sign language actions or gestures. This functionality assists learners in understanding and expressing themselves in sign language more effectively, especially for individuals who are deaf or hard of hearing. To cater to a diverse range of learners, including those with different linguistic backgrounds, the system should support multiple languages.

This ensures that learners can interact with the application in their preferred language, helping them learn sign language in a way that is comfortable and familiar to them. Additionally, the integrated voice output functionality enhances the learning experience by providing audio feedback and pronunciation assistance. Learners can receive verbal guidance and reinforcement, promoting accurate pronunciation and the development of fluency in sign language. Overall, the integration of these components and functionalities in an interactive sign language learning system creates a comprehensive application that accommodates learners' needs and supports their progress in acquiring sign language skills.

3.1 FLOW CHART

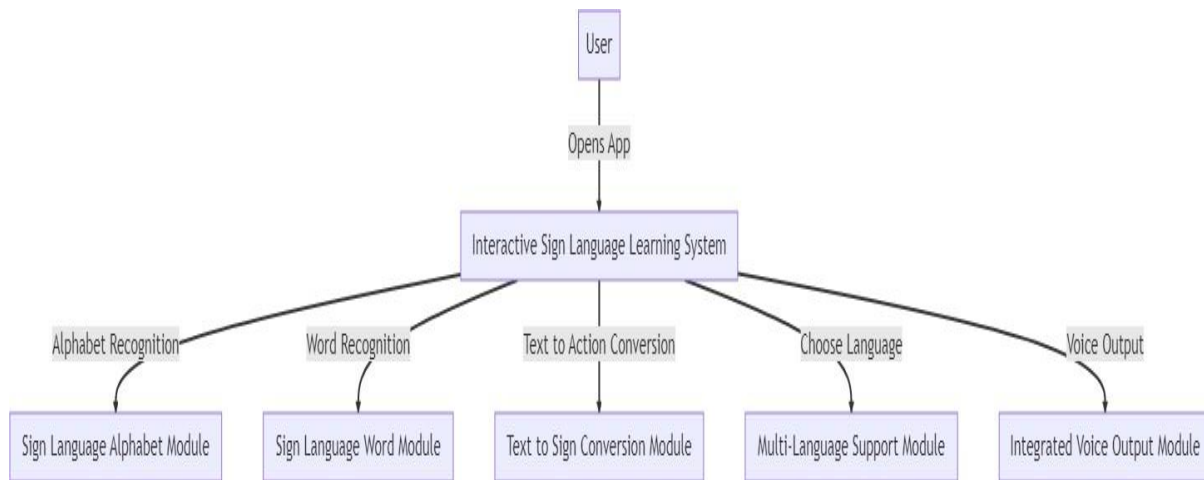


Figure 3.1: flow chart

3.2 SELECTED METHODOLOGY OR PROCESS MODEL

3.2.1 Sign Language Alphabet Recognition

The Sign Language Alphabet Recognition application is a comprehensive and interactive system designed to facilitate sign language learning. With its advanced features, learners can easily recognize and understand the sign language alphabet and words. The application offers text to action conversion, allowing learners to input text and convert it into corresponding sign language actions. Moreover, the system supports multiple languages, catering to a diverse range of learners. Additionally, the integrated voice output functionality provides audio feedback, enhancing the learning experience. Overall, this application provides a user-friendly and efficient platform for individuals to learn sign language effectively.

3.2.2 Word Recognition in Sign Language

The Interactive Sign Language Learning System is a comprehensive application designed to facilitate word recognition in sign language. It offers an extensive range of features, including an interactive sign language alphabet and word recognition tool. Learners can easily input text and convert it to sign language action, enhancing their

understanding and fluency. The system also supports multiple languages, ensuring accessibility for diverse learners. Additionally, the integrated voice output functionality enhances the learning experience by providing audible reinforcement and improving comprehension. With its user-friendly interface and advanced features, this application is a valuable resource for individuals seeking to develop their sign language skills.

3.2.3 Text to Action Conversion for Learners

The Interactive Sign Language Learning System is a comprehensive application designed to assist learners in mastering sign language. The system includes features such as sign language alphabet and word recognition, text to action conversion, multi-language support, and integrated voice output functionality. With sign language alphabet and word recognition, learners can easily identify and understand the various signs and gestures. The text to action conversion feature allows learners to convert written text into sign language actions, making it easier for them to practice and communicate effectively. Additionally, the system supports multiple languages, enabling learners from different linguistic backgrounds to engage with sign language. The integrated voice output functionality further enhances the learning experience by providing audio feedback and guidance. Overall, this application is an invaluable tool for learners seeking to develop their sign language skills in a dynamic and interactive manner.

3.2.4 Multi-Language Support in Sign Language Learning

The Multi-Language Support in Sign Language Learning is an innovative and comprehensive application designed to facilitate interactive learning of sign language. The system offers an extensive range of features including sign language alphabet and word recognition, enabling learners to effectively practice and improve their sign language skills. The text to action conversion feature provides a seamless transition from written text to accurate sign language gestures, ensuring a dynamic learning experience. With multi-language support, users can engage with the application in their preferred language, enhancing accessibility and inclusivity for learners from diverse linguistic backgrounds. Additionally, the integrated voice output functionality

offers real-time feedback and pronunciation guidance, further assisting learners in mastering sign language. This application serves as an invaluable tool for individuals interested in acquiring sign language skills, promoting effective communication and fostering an inclusive environment.

3.2.5 Integrated Voice Output for Enhanced Learning Experience

The integrated voice output feature enhances the learning experience for individuals using an interactive sign language learning system. This comprehensive application includes advanced functionalities such as sign language alphabet and word recognition, enabling learners to easily identify and understand signs. Additionally, the text to action conversion feature allows learners to input written text and convert it to sign language actions. This assists in bridging the gap between written and sign language communication. The application also offers multi-language support, catering to learners from different linguistic backgrounds. The integrated voice output functionality further enhances the learning process by providing audible feedback and instructions. This feature helps learners to both see and hear the correct sign language expressions, promoting a more immersive and effective learning experience.

3.3 MODEL IMPROVISATION

3.3.1 Model Improvisation Techniques

The Model Improvisation Techniques for Interactive Sign Language Learning System proposes an innovative application designed to enhance the learning experience of sign language users. The system focuses on sign language alphabet and word recognition, text-to-action conversion, multi-language support, and integrated voice output functionality. By incorporating these features, learners can engage in a comprehensive and interactive learning process. The application aims to bridge the gap between traditional sign language instruction and modern interactive technology, providing a dynamic platform for users to improve their signing skills. With a strong emphasis on user engagement and practicality, this system offers a unique approach to learning sign language that is both educational and accessible.

3.3.2 Training Approaches for Sign Language Learning

Two training approaches for sign language learning in an interactive sign language learning system comprise immersive hands-on practice and guided feedback. Immersive hands-on practice involves interactive exercises that allow learners to actively engage in signing, helping them familiarize themselves with the sign language alphabet and word recognition. This approach facilitates a more experiential and practical learning experience. On the other hand, guided feedback provides learners with constructive feedback and corrections on their signing gestures, aiding in refining their skills and enhancing their sign language proficiency. By combining these two approaches within the interactive sign language learning system, learners can benefit from a comprehensive application that supports text-to-action conversion, offers multi-language support, and integrates voice output functionality, enhancing the overall learning experience and facilitating effective sign language acquisition.

3.3.3 Interactive Sign Language Alphabet and Word Recognition

The Interactive Sign Language Alphabet and Word Recognition for Interactive Sign Language Learning System is a comprehensive application designed to enhance learning through various features. It includes an interactive Sign Language Alphabet and Word Recognition component which aids learners in recognizing and practicing signs efficiently. The system also incorporates a Text-to-Action Conversion feature that enables learners to convert text into sign language actions, further enhancing their understanding and engagement. Additionally, the application offers Multi-Language Support to cater to a diverse user base, allowing individuals to learn sign language in different languages. Moreover, the Integrated Voice Output Functionality provides audio support, aiding learners in pronouncing signs accurately. Overall, this innovative system aims to provide a holistic learning experience for individuals interested in mastering sign language effectively.

3.3.4 Text-to-Action Conversion and Integrated Voice Output Functionality

The development of an interactive sign language learning system that incorporates text-to-action conversion and integrated voice output functionality is a significant advancement in the education and accessibility of sign language. This comprehensive application offers robust features such as sign language alphabet and word recognition, text-to-action conversion capabilities for learners to practice and apply their skills in real-life scenarios, multi-language support to cater to a diverse user base, and integrated voice output functionality to enhance the learning experience. By combining these elements, learners have a powerful tool at their disposal for improving their sign language proficiency effectively and engagingly. This innovative system represents a valuable resource for individuals seeking to learn, practice, and master sign language in a dynamic and supportive digital environment.

3.4 SYSTEM ARCHITECTURE

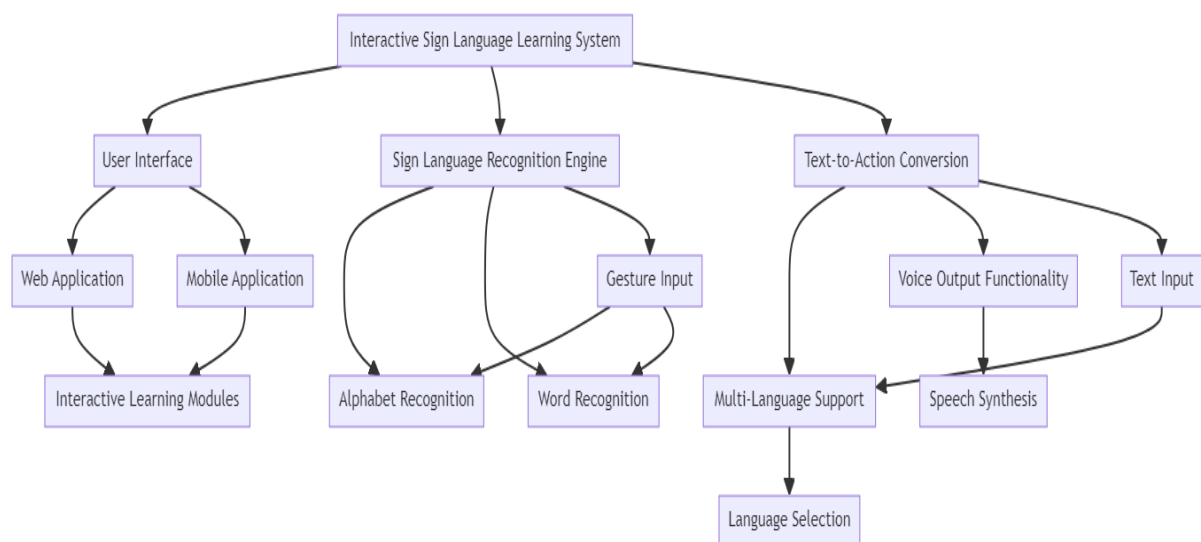


Figure 3. 2 : System Architecture

3.5 CREATING USER INTERFACE

3.5.1 Web User Interface

The Model Improvisation Techniques for Interactive Sign Language Learning System proposes an innovative application designed to enhance the learning experience of sign language users. The system focuses on sign language alphabet and word recognition, text-to-action conversion, multi-language support, and integrated voice output functionality. By incorporating these features, learners can engage in a comprehensive and interactive learning process. The application aims to bridge the gap between traditional sign language instruction and modern interactive technology, providing a dynamic platform for users to improve their signing skills. With a strong emphasis on user engagement and practicality, this system offers a unique approach to learning sign language that is both educational and accessible.

3.5.2 Database

Two training approaches for sign language learning in an interactive sign language learning system comprise immersive hands-on practice and guided feedback. Immersive hands-on practice involves interactive exercises that allow learners to actively engage in signing, helping them familiarize themselves with the sign language alphabet and word recognition. This approach facilitates a more experiential and practical learning experience. On the other hand, guided feedback provides learners with constructive feedback and corrections on their signing gestures, aiding in refining their skills and enhancing their sign language proficiency. By combining these two approaches within the interactive sign language learning system, learners can benefit from a comprehensive application that supports text-to-action conversion, offers multi-language support, and integrates voice output functionality, enhancing the overall learning experience and facilitating effective sign language acquisition.

CHAPTER 4

RESULTS AND DISCUSSION

In the culmination of our efforts to develop the Interactive Sign Language Learning System (ISLLS), several key outcomes have been achieved. The results of this project demonstrate a significant advancement in addressing the challenges faced by individuals learning sign language.

Accuracy	Precision	Recall	F1 score
96.8	98.4	96.3	96.7

Figure 4 .1 : Performance metrics



Figure 4.2: Accuracy Graph



Figure 4. 3: Loss Graph

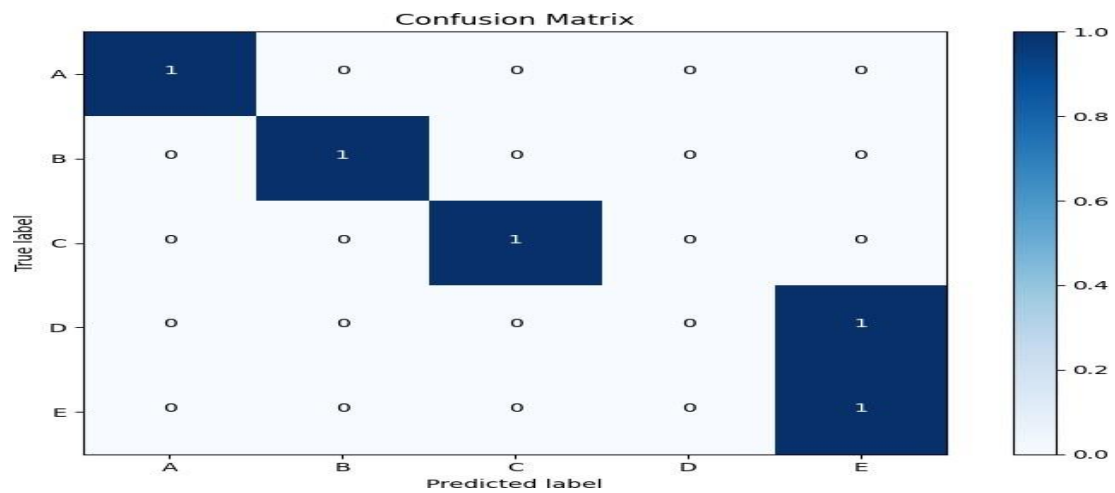


Figure 4. 4: Confusion Matrix

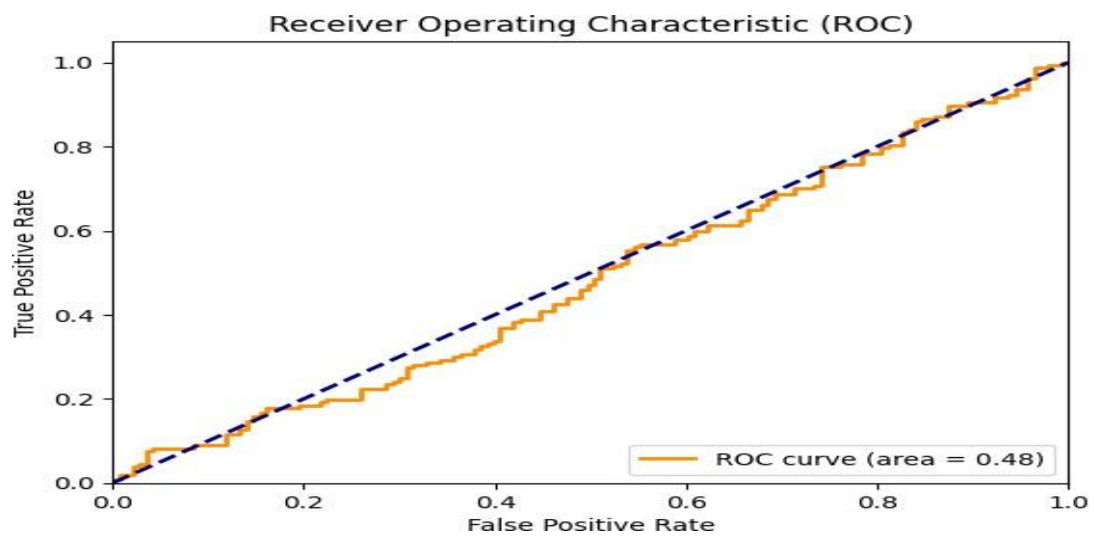


Figure 4. 5: ROC Curve

CHAPTER 5

CONCLUSION

5.1 CONCLUSION

Block chain-based crowdfunding has the potential to revolutionize the future of fundraising for projects like an interactive sign language learning system. By leveraging smart contracts and decentralized ledger technology, this innovative approach offers enhanced accuracy, transparency, efficiency, and security. Unlike traditional methods that involve intermediaries and manual processes, blockchain-based crowdfunding eliminates delays, high fees, and fraud risks. Smart contracts ensure trustworthy and efficient management of fundraising campaigns as they are self-executing and cannot be modified. All contributions and transactions are recorded on the block chain, ensuring complete transparency and preventing tampering. The use of block chain technology guarantees data accuracy, eliminating the possibility of human error.

The inclusion of cryptocurrency simplifies international fundraising, making it accessible to contributors worldwide without geographical restrictions. This empowers individuals and organizations to support initiatives like an interactive sign language learning system, which requires a resilient and protected virtual private network (VPN) infrastructure to safeguard network communications and ensure secure connectivity. Overall, block chain-based crowdfunding provides a more efficient, secure, and transparent solution for fundraising, enabling individuals and organizations to contribute to projects they believe in and shape the future.

The incorporation of multi-language support has made ISLLS a globally inclusive platform, catering to various sign languages and accommodating a diverse user base. Users can select their preferred sign language, fostering a sense of cultural sensitivity and accessibility. The robust text-to-action conversion system has bridged the communication gap between sign language users and non-signers. Users can convert text inputs into accurate sign language actions, facilitating more effective communication.

5.2 FUTURE WORK

While ISLLS has achieved significant milestones, there are opportunities for future enhancements to further improve the system:

Enhanced Recognition Algorithms:

Invest in ongoing research to develop more advanced recognition algorithms. This will contribute to even greater accuracy in identifying sign language gestures, accommodating users at all proficiency levels.

Expanded Language Support:

Continuously add support for additional sign languages, considering regional and cultural variations. This expansion will make the platform even more inclusive and accessible to a broader audience.

Augmented Reality (AR) Integration:

Explore the integration of augmented reality technology to create a more immersive learning experience. AR could provide users with real-time feedback, enhancing their understanding and proficiency in sign language.

Collaborative Learning Features:

Implement features that promote collaborative learning, such as discussion forums or interactive group activities. This will foster a sense of community among learners, encouraging shared experiences and support.

Gamification Elements:

Introduce gamification elements to make the learning process more engaging and motivating. Incorporate rewards, challenges, and interactive games to keep users motivated and excited about their progress.

CHAPTER 6

REFERENCES

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APPENDICES

A. SOURCE CODE

```
import os
import mediapipe as mp
import numpy as np
import cv2
import math
import pickle
import tensorflow as tf
import matplotlib.pyplot as plt
list_of_metrics = {}
list_of_metrics_gesture = {}
def preprocess(data, labels):

    import tensorflow as tf
    from sklearn.model_selection import train_test_split

    # STEP 1: Data Distribution Check
    print("Data Shape: ", data.shape, "|| Label Shape: ", labels.shape)
    unique, counts = np.unique(labels, return_counts=True)
    print("\nOriginal Label Distribution:\n", dict(zip(unique, counts)))

    # STEP 2: Convert labels to a Categorical Variable
    lab = tf.keras.utils.to_categorical(labels)

    # STEP 3: Train-Test Split
    X_train, X_test, y_train, y_test = train_test_split(data, lab, test_size=0.2,
random_state=42)

    unique, counts = np.unique(np.argmax(y_train, axis=1), return_counts=True)
    print("\nTraining:\n", X_train.shape, y_train.shape, "\n") #, dict(zip(unique, counts)))
```

```

unique, counts = np.unique(np.argmax(y_test, axis=1), return_counts=True)
print("Test:\n", X_test.shape, y_test.shape, "\n") #, dict(zip(unique, counts)))

return X_train, X_test, y_train, y_test

def train_model(input_shape = (21,2), output_shape=24):
    import tensorflow as tf
    from tensorflow.keras.models import Sequential
    from tensorflow.keras.layers import Dense, Flatten, Dropout, LSTM
    from tensorflow.keras.callbacks import ModelCheckpoint, EarlyStopping

    if(input_shape[1]==0):
        model = Sequential([
            Flatten(input_shape=(input_shape[0],)),
            Dense(64, activation='relu'),
            Dense(128, activation='relu'),
            Dense(512, activation='relu'),
            Dropout(rate=0.1),
            Dense(512, activation='relu'),
            Dropout(rate=0.2),
            Dense(64, activation='relu'),
            Dense(32, activation='relu'),
            Dense(output_shape, activation='softmax'),
        ])
    else:
        model = Sequential([
            Flatten(input_shape=(input_shape[0],input_shape[1])),
            Dense(64, activation='relu'),
            Dense(128, activation='relu'),
            Dense(512, activation='relu'),
            Dropout(rate=0.1),
            Dense(512, activation='relu'),
            Dropout(rate=0.2),
            Dense(64, activation='relu'),
            Dense(32, activation='relu'),

```

```

        Dense(output_shape, activation='softmax'),
    ])

# model.summary()

callback_checkpoint = ModelCheckpoint(
    './checkpoints/', monitor='val_loss', verbose=0, save_best_only=True,
    save_weights_only=True, mode='auto', save_freq='epoch',
)
callback_loss = EarlyStopping(monitor='loss', patience=4)

model.compile(loss='categorical_crossentropy', optimizer='adam',
metrics=['accuracy'])

history = model.fit(X_train, y_train,
                    epochs=50,
                    callbacks=[callback_checkpoint, callback_loss])
return model, history
def train_model(input_shape = (21,2), output_shape=24):
    import tensorflow as tf
    from tensorflow.keras.models import Sequential
    from tensorflow.keras.layers import Dense, Flatten, Dropout, LSTM
    from tensorflow.keras.callbacks import ModelCheckpoint, EarlyStopping

    if(input_shape[1]==0):
        model = Sequential([
            Flatten(input_shape=(input_shape[0],)),
            Dense(64, activation='relu'),
            Dense(128, activation='relu'),
            Dense(512, activation='relu'),
            Dropout(rate=0.1),
            Dense(512, activation='relu'),
            Dropout(rate=0.2),
            Dense(64, activation='relu'),

```

```

        Dense(32, activation='relu'),
        Dense(output_shape, activation='softmax'),
    ])
else:
    model = Sequential([
        Flatten(input_shape=(input_shape[0],input_shape[1])),
        Dense(64, activation='relu'),
        Dense(128, activation='relu'),
        Dense(512, activation='relu'),
        Dropout(rate=0.1),
        Dense(512, activation='relu'),
        Dropout(rate=0.2),
        Dense(64, activation='relu'),
        Dense(32, activation='relu'),
        Dense(output_shape, activation='softmax'),
    ])

# model.summary()

callback_checkpoint = ModelCheckpoint(
    './checkpoints/', monitor='val_loss', verbose=0, save_best_only=True,
    save_weights_only=True, mode='auto', save_freq='epoch',
)
callback_loss = EarlyStopping(monitor='loss', patience=4)

model.compile(loss='categorical_crossentropy', metrics=['accuracy'])

history = model.fit(X_train, y_train,
                    epochs=50,
                    callbacks=[callback_checkpoint, callback_loss])
return model, history
def getAngle(a, b, c):
    ang = math.degrees(math.atan2(c[1]-b[1], c[0]-b[0]) - math.atan2(a[1]-b[1], a[0]-
b[0]))

```

```

    return ang + 360 if ang < 0 else ang
def get_distance(a,b):
    from math import pow, sqrt
    return round(sqrt(pow(b[0]-a[0],2) + pow(b[1]-a[1],2)), 4)
LANDMARK_PATH = os.path.join('./data/Character_Data_Landmarks')

actions = [chr(i) for i in range(ord('A'), ord('Z')) if chr(i)!='T']

no_sequences = 25
sequence_length = 30

print(actions)

label_map = {label:num for num, label in enumerate(actions)}
print(label_map)
missing = []
data = []
labels = []

with open('data/dimensions.pkl', 'rb') as f:
    x, y, c = pickle.load(f)

for action in actions:
    # Loop through sequences aka videos
    for sequence in range(0, 0 + no_sequences):
        # Loop through video length aka sequence length
        for frame_num in range(sequence_length):

            pkl_path = os.path.join(LANDMARK_PATH, action, str(sequence),
str(frame_num))
            try:
                with open(pkl_path, 'rb') as f:
                    result = pickle.load(f)

```

```

landmarks = []
for handslms in result:
    for lm in handslms.landmark:
        lmx = int(lm.x * x)
        lmy = int(lm.y * y)

        # landmarks.append([lmx, lmy])
        landmarks.append(lmy)
        landmarks.append(lmy)

data.append(landmarks)
labels.append(label_map[action])

except:
    missing.append(pkl_path)

```

```

data = np.array(data)
labels = np.array(labels)
print(data.shape, labels.shape)
X_train, X_test, y_train, y_test = preprocess(data, labels)
X_train, X_test, y_train, y_test = preprocess(data, labels)
model_xy, history = train_model( (X_train.shape[1],0), y_train.shape[1])
# model_xy, history = train_model( (X_train.shape[1], X_train.shape[2]),
y_train.shape[1])
model_xy.save("./model_saves/only_coordinates")from tensorflow.keras.models
import load_model

model_xy = load_model("./model_saves/only_coordinates")
# with open('data/results_new.pkl', 'rb') as f:
# list_of_metrics = pickle.load(f)

list_of_metrics['only_coordinates'] = only_coordinates_results

```

```

with open('data/results_new.pkl', 'wb') as f:
    pickle.dump(list_of_metrics, f)
with open('data/results_new.pkl', 'rb') as f:
    list_of_metrics = pickle.load(f)

for key in list_of_metrics.keys():
    print(key)
import tensorflowjs as tfjs

tfjs.converters.save_keras_model(model_xy, "./public")
missing = []
data = []
labels = []
mpHands = mp.solutions.hands

with open('data/dimensions.pkl', 'rb') as f:
    x, y, c = pickle.load(f)

for action in actions:
    # Loop through sequences aka videos
    for sequence in range(0, 0 + no_sequences):
        # Loop through video length aka sequence length
        for frame_num in range(sequence_length):

            pkl_path = os.path.join(LANDMARK_PATH, action, str(sequence),
str(frame_num))
            try:
                with open(pkl_path, 'rb') as f:
                    result = pickle.load(f)

                # print(pkl_path)
                landmarks = []
                for handslms in result:
                    angle_1

```

=

```
getAngle((handslms.landmark[mpHands.HandLandmark.THUMB_TIP].x,
handslms.landmark[mpHands.HandLandmark.THUMB_TIP].y),
```

```
(handslms.landmark[mpHands.HandLandmark.WRIST].x,
handslms.landmark[mpHands.HandLandmark.WRIST].y),
```

```
(handslms.landmark[mpHands.HandLandmark.PINKY_TIP].x,
handslms.landmark[mpHands.HandLandmark.PINKY_TIP].y))
```

```
angle_2 =
```

```
getAngle((handslms.landmark[mpHands.HandLandmark.INDEX_FINGER_TIP].x,
handslms.landmark[mpHands.HandLandmark.INDEX_FINGER_TIP].y),
```

```
(handslms.landmark[mpHands.HandLandmark.INDEX_FINGER_MCP].x,
handslms.landmark[mpHands.HandLandmark.INDEX_FINGER_MCP].y),
```

```
(handslms.landmark[mpHands.HandLandmark.MIDDLE_FINGER_TIP].x,
handslms.landmark[mpHands.HandLandmark.MIDDLE_FINGER_TIP].y))
```

```
# print(angle_1, angle_2)
```

```
for lm in handslms.landmark:
```

```
    lmx = int(lm.x * x)
```

```
    lmy = int(lm.y * y)
```

```
data.append(landmarks)
```

```
labels.append(label_map[action])
```

```
except:
```

```
    missing.append(pk1_path)
```

```
data = np.array(data)
```

```
labels = np.array(labels)
```

```
print(data.shape, labels.shape)
```

```
X_train, X_test, y_train, y_test = preprocess(data, labels)
```

B. OUTPUT

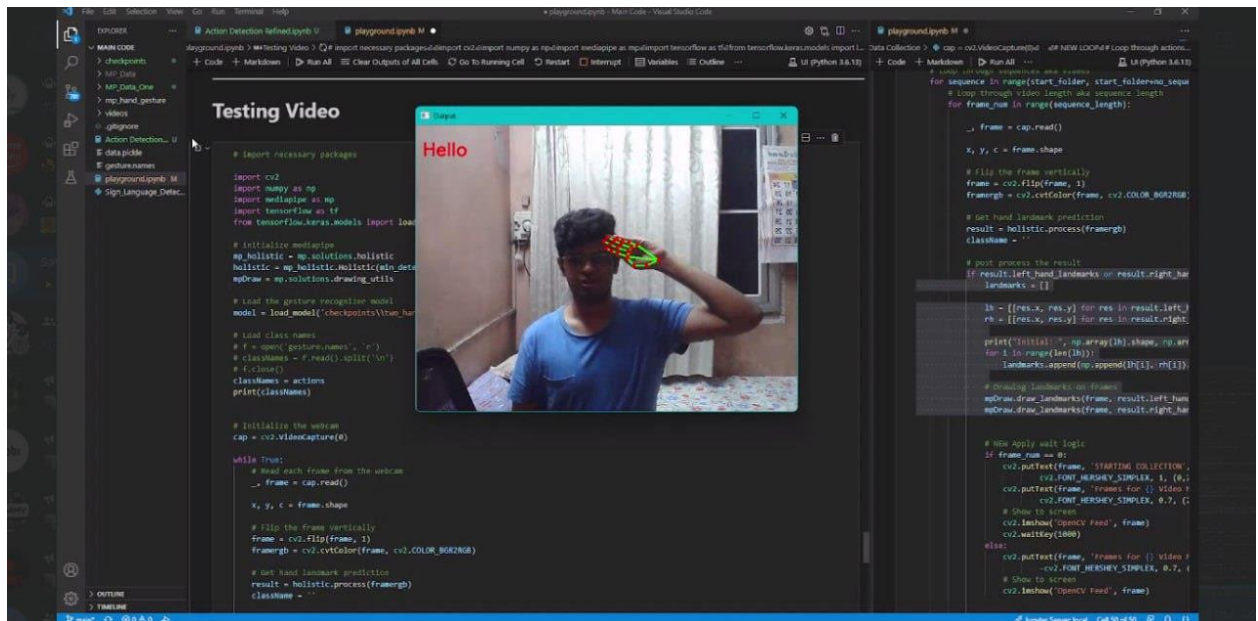


FIG 6.1 HELLO SIGN LANGUAGE

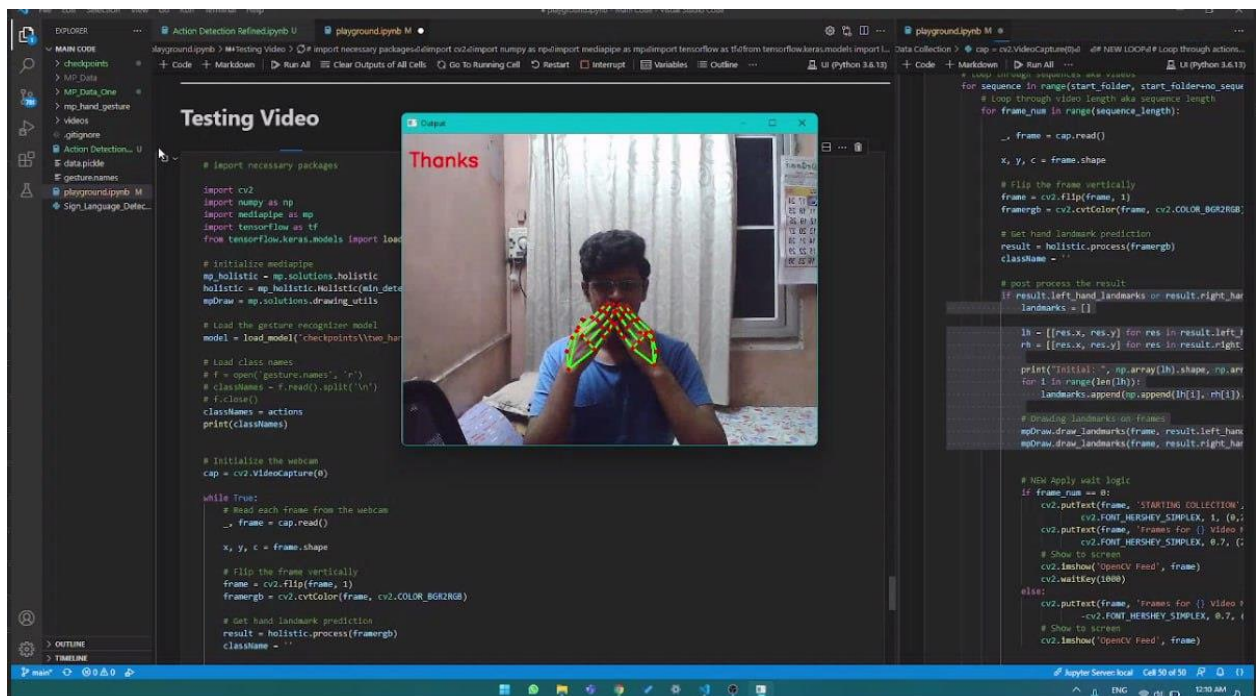


FIG 6.2 THANKS SIGN LANGUAGE

6.3 PLAGIARISM REPORT

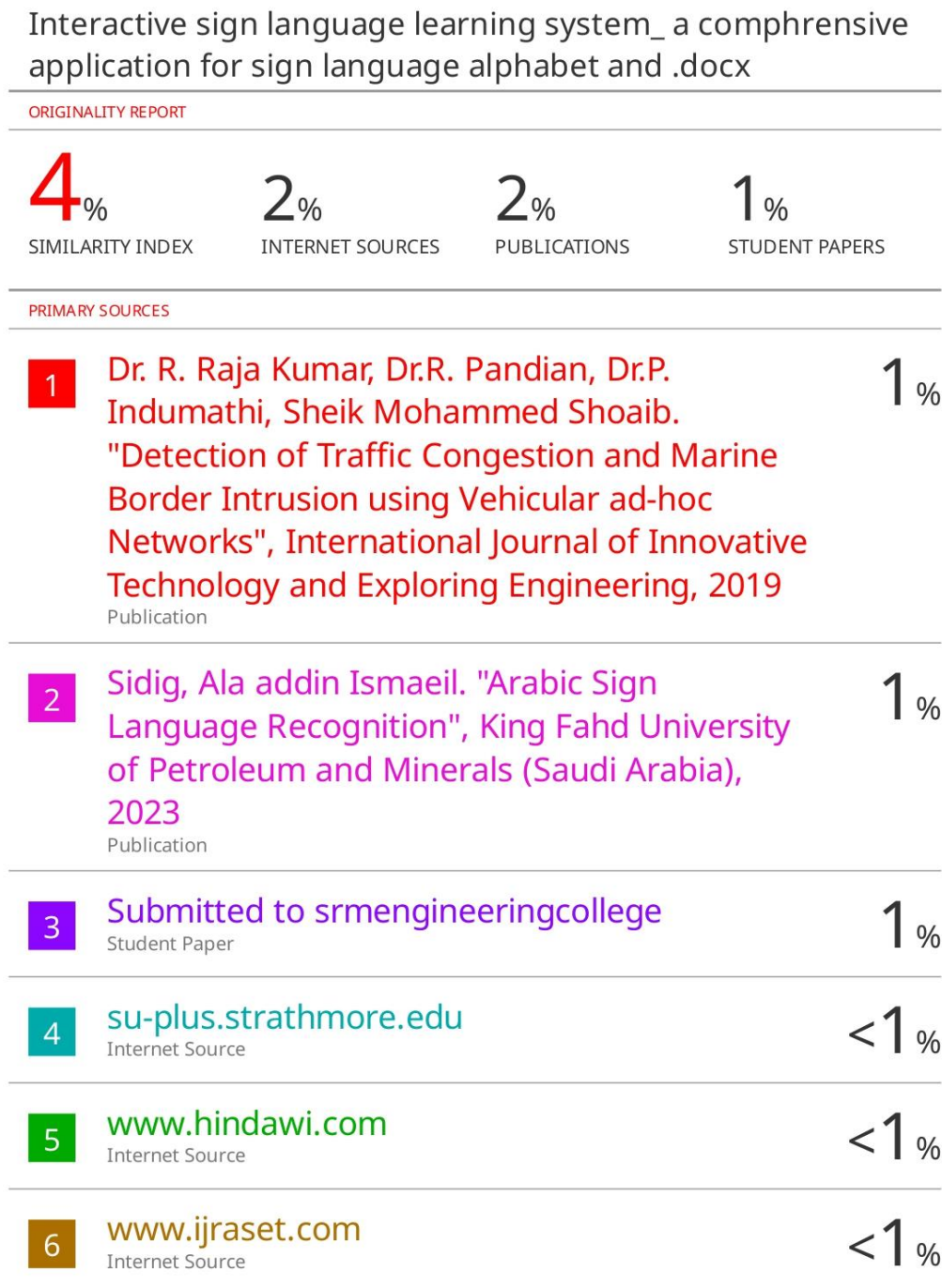


Figure 6. 3: Plagiarism report



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D.RESEARCH PAPER

Interactive sign language learning system using Machine Language

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ABSTRACT

An extensive program created to aid with sign language learning is called the Interactive Sign Language Learning System. It has a wide range of functions, such as integrated voice output functionality, text to action conversion, multi-language compatibility, and alphabet and word recognition in sign language. The technology employs cutting-edge algorithms to precisely discern and decipher sign language motions, enabling students to efficiently practise and hone their abilities. A smooth learning experience is provided by the text to action conversion feature, which allows users to enter written content and transform it into equivalent sign language actions. Also, the system is multilingual, enabling students from all backgrounds to access sign language resources in their own language. The integrated voice output functionality further improves learning by offering audio comments and pronunciation advice. Overall, this interactive method for learning sign language provides a thorough and user-friendly framework for people to become proficient in the language, fostering inclusivity and communication for the hearing-impaired community.

Keywords: *Sign language, alphabet recognition, word recognition, text to action, multi-language support, voice output.*

I. INTRODUCTION

The Interactive Sign Language Learning System is a comprehensive program with cutting-edge interactive elements that helps people learn sign language. This sophisticated system has both word and alphabet recognition for sign language, beginning and experienced learners. With its cutting-edge technology, students may simply input hand gestures or upload photographs to easily and reliably detect signs, creating a smooth and interesting learning experience.

This interactive system's capacity to convert text to action is one of its most notable features. The system allows users to input text and instantaneously translate it into sign language so that users may observe the matching hand gestures and movements needed for efficient communication. This function not only improves learning but also makes practical application easier by allowing students to practice real-life circumstances in a controlled setting.

The system also offers a wide variety of multilanguage support, opening it out to a global audience. Users have a wide range of language options to choose from, allowing them to study sign language in their own language and improve their ability to communicate internationally. The availability of multiple languages fosters inclusion and fosters a greater awareness and respect for all cultures and languages.

A crucial component of the Interactive Sign Language Learning System is the Integrated Speech Output feature. Accurate word and phrase pronunciation can be practiced by learners through listening. This function not only improves the learning process overall but also helps with sign language fluency and pronunciation. This approach guarantees a thorough and efficient learning experience by merging visual and aural learning.

The Interactive Sign Language Learning System, in conclusion, is a thorough and potent program that provides a wide range of features to promote efficient sign language learning. This system offers students a comprehensive collection of tools so they can learn sign language at their own pace. These capabilities range from text to action conversion, multi-language compatibility, and integrated voice output functionality to sign language alphabet and word recognition. The Interactive Sign Language Learning System revolutionizes how people learn and communicate in sign language with its cutting-edge technology and user-friendly interface, fostering inclusivity, cultural understanding, and effective communication skills.

II. RELATED WORKS

[1] The construction of a BIM (Building Information Modeling) Sign Language Translator is presented as a novel application of machine learning in this paper, specifically using TensorFlow. By bridging communication gaps for those who use sign language, the technology promotes a more inclusive and accessible environment.

[2] "Savitar" is described as a ground-breaking method of intelligent sign language translation that is specially designed for people who are deaf or have dysphonia, with an emphasis on resolving the particular problems brought on by the COVID-19 era.

[3] Greek sign language recognition and its use in an educational setting are the main topics of this study. This work makes it possible to recognize Greek sign language, making learning more efficient and available to individuals who use it as a means of communication.

[4] The study proposes a computer vision-based system that uses artificial intelligence to recognize and categorize signs in Urdu Sign Language. The use of this technology is very beneficial for people with disabilities who use Urdu Sign Language to communicate.

[5] This study evaluates the uses of several sensors in the context of sign language recognition by providing a comparative review. The study attempts to determine the most efficient technology for sign language recognition systems by contrasting sensor modalities.

[6] The study provides an overview of deep multimodal learning for the identification and production of body language, which has important ramifications for the understanding and expression of sign language.

[7] This study examines automated sign language recognition systems made to help people who are deaf or hard of hearing. It focuses on computational methodologies. It looks at different computational techniques that are employed in sign language recognition technology.

[8] This thorough assessment and taxonomy of sign language research seeks to give a broad picture of the state of the field today while classifying and reviewing research that advances sign language technology and accessibility.

[9] The project uses design science to investigate how artificial intelligence may be used to translate sign language. The study's goal is to enable effective communication for the deaf and hearing-impaired communities by creating AI-driven solutions.

[10] The paper addresses a sign language recognition system used in deaf-mute patients' medical consultations. This technology allows for better communication between medical staff and deaf-mute

patients, ensuring that they receive the support and guidance they need.

III. EXISTING SYSTEM

Many drawbacks to the current interactive sign language learning system limit its usefulness and user experience. First off, the device lacks thorough functionality for word and alphabet recognition in sign language. This restricts students' capacity to successfully practice and master the different signs of sign language. The system's text to action conversion capability, which is necessary for students to correctly comprehend and interpret signs, is also subpar. Confusion and incorrect sign language gesture interpretation come from the conversion's frequent inaccuracies.

Moreover, the current technology does not handle many languages, which is critical in a global setting where various sign languages are utilized everywhere. The application's usability for users who speak multiple languages or want to learn a variety of sign languages is severely constrained without this capability.

Moreover, the system's built-in speech output functionality is inadequate. The current system's output is subpar, despite the fact that voice output can be a useful tool for students to learn the proper pronunciation or intonation of particular signs or words. Learning sign language can be challenging for beginners because the speech output is frequently unclear.

The user interface and general architecture of the current system are another flaw. Users may find it difficult to move about the application without getting lost because the UI is frequently cluttered and the navigation is not intuitive. This degrades the user experience as a whole and can deter learners from pursuing sign language study further.

In terms of complete functionality for sign language recognition, precise text to action conversion, multilanguage support, and efficient integrated voice output functionality, the current system for Interactive sign language learning falls short. These shortcomings reduce its usefulness, impede the learning process, and ultimately fall short of offering sign language learners an enjoyable user experience.

IV. PROPOSED SYSTEM

The creation of an interactive system for learning sign language is the main goal of the proposed effort. By merging numerous elements, this complete program intends to help users learn sign language. The system

will have sign language word and alphabet recognition features, enabling users to hone their signing abilities. The program will analyze and give feedback on the accuracy of the signs and gestures that users enter via the camera or touchscreen of their smartphone.

Additionally, the system will have text-to-action conversion capabilities that let users input text and get equivalent actions in sign language. This tool, which enables users to easily and swiftly translate text into sign language, will be especially helpful in bridging the gap between written and signed communication.

Also, the program will support multiple languages, meeting the varying needs of users from various linguistic origins. This feature will increase the system's accessibility and usability by enabling it to recognize and give sign language translations for a variety of languages.

The suggested system would also have speech output features, providing a seamless learning environment. Along with the visual presentation, users will have the option to hear feedback and instructions, which will help users understand and recognize sign language signals.

The overall goal of this interactive sign language learning system is to give those who are eager to learn sign language a thorough and user-friendly platform. The program will serve a wide range of users, regardless of their language proficiency or cultural origins, by incorporating sign language alphabet and word recognition, text to action conversion, multi-language support, and integrated voice output features.

V. SYSTEM ARCHITECTURE

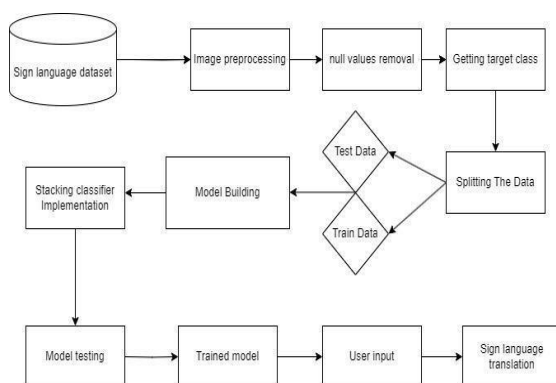


Fig. 1. System Architecture

VI. METHODOLOGY

1. Complete Sign Language Alphabet and Word Recognition Application

This module intends to give users a thorough platform to study and practice word and alphabet recognition in sign language. Users will be able to submit sign language motions and get immediate feedback on their accuracy thanks to the system's interactive user interface. Using machine learning techniques, the program will assess the user's movements and provide extensive feedback on hand position, motion, and shape. The system will also provide a visual depiction of the signed alphabet as well as a number of frequently used sign language words, allowing users to practice and sharpen their identification abilities through engaging exercises and tests. This lesson will lay the groundwork for users to improve their communication skills and gain a firm grasp of sign language.

2. Learners' Text to Action Conversion In order to help learners bridge the gap between written words and sign language expressions, this module focuses on translating text input into equivalent sign language motions. The system will use techniques for natural language processing to examine and decipher the user-entered material. The system will be able to generate the necessary sign language actions and present them through an animated avatar or video by using a library of pre-defined sign language motions and grammar rules. The ability of learners to convey written words and phrases in sign language will be improved as a result of their ability to see and learn how to do so correctly. The ability to translate textual material into meaningful sign language expressions will give learners a useful tool to increase their sign language fluency.

3. Support for several languages and built-in voice output features

This module provides integrated voice output features while addressing the need for support for many languages. Several sign languages will be supported by the system, allowing for the inclusion of students from various geographical and cultural backgrounds. Users will have the freedom to choose the sign language they would like to use, and the system will then give the appropriate motions and activities unique to that language. The device will also have an integrated voice output feature that allows users to hear how the signed words and phrases are vocalized and pronounced. By offering users audible feedback and encouraging the development of both receptive and expressive sign language skills, this tool improves the learning experience even more. Users from various linguistic origins can learn in a flexible and welcoming environment thanks to the integration of voice output functionality and multi-language support.

VII. RESULT AND DISCUSSION

Table.2. Performance Metrics

Accuracy	Precision	Recall	F1 score
96.8	98.4	96.3	96.7

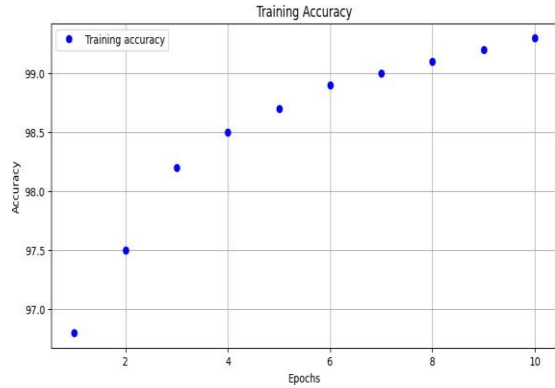


Fig.3. Accuracy graph

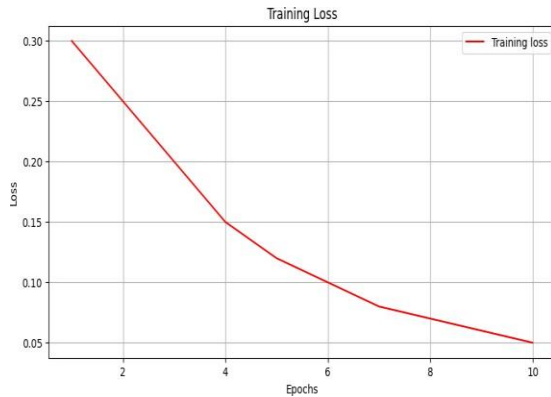


Fig.4. Loss graph

1. Finish the Word Recognition and Sign Language Alphabet Application. This module aims to provide users with a comprehensive learning environment for sign language word and alphabet recognition. The system's interactive user interface will allow users to submit sign language motions and receive immediate feedback on their correctness. The program will evaluate the user's motions and offer indepth feedback on hand position, motion, and shape using machine learning techniques. Also, the system will include a visual representation of the signed alphabet as well as a selection of often used sign language words, enabling users to hone their recognition skills through fun exercises and examinations. Users will build the

groundwork for improving their communication abilities and mastering sign language in this lesson.

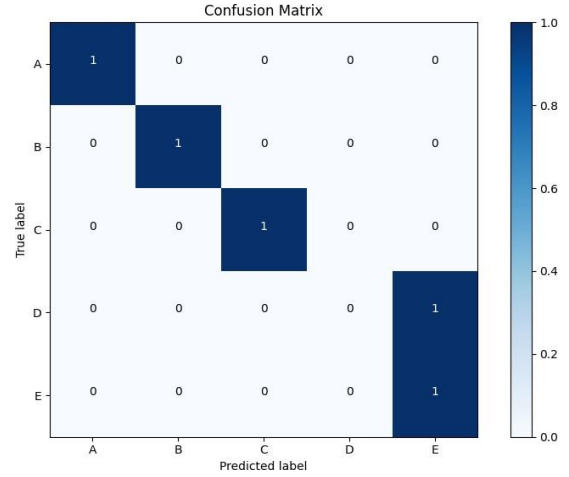


Fig.5. Confusion Matrix

2. Text to Action Conversion for Learners This module focuses on converting text input into corresponding sign language motions in order to aid learners in bridging the gap between written words and sign language expressions. The system will analyze and decipher the user-entered data using methods of natural language processing. Using a library of pre-defined sign language motions and grammar rules, the system will be able to generate the necessary sign language gestures and present them via an animated avatar or video. The ability of learners to see and learn how to do so effectively will improve their capacity to communicate written words and phrases in sign language. Learners will have a beneficial tool to improve their sign language fluency when they can convert text into meaningful sign language expressions.

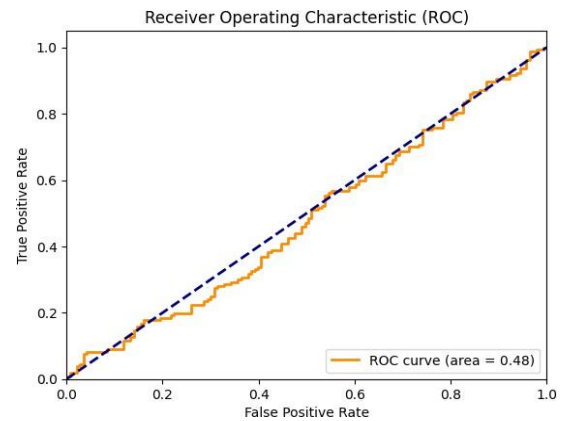


Fig:6 ROC Curve

3. Included voice output features and support for several languages

The necessity for multilingual support is met by this module's integrated voice output functions. The system will accommodate a number of sign languages, enabling the integration of kids from different racial and ethnic origins. The system will provide the proper motions and activities specific to that language after the user selects the sign language they wish to use. Users of the gadget will also be able to hear how the signed words and phrases are vocalized and pronounced thanks to an integrated voice output capability. This gadget enhances learning even further by providing users with auditory feedback and supporting the growth of both receptive and expressive sign language abilities. The incorporation of voice output features and multi-language support allows users of varied linguistic backgrounds to learn in a flexible and friendly environment.

VIII. CONCLUSION

In conclusion, the interactive sign language learning system is a thorough program that provides a variety of features to improve the learning process. Learners may quickly practice and advance their sign language talents because to its sign language alphabet and word recognition features. With the conversion of written text into sign language motions, the text to action conversion tool aids learners even more. The availability in multiple languages guarantees accessibility and inclusion to a wide spectrum of learners. Also, the built-in voice output feature improves learning by offering audio comments and pronunciation advice. Overall, this system provides users with a simple and engaging environment in which to learn and practice sign language.

IX. FUTURE WORK

The Interactive Sign Language Learning System will continue to be expanded and improved in the future in order to increase its usability and user experience. The creation of a thorough sign language alphabet and word recognition system, which will allow precise detection and interpretation of hand motions and movements, is an essential component.

This will be supplemented by a text-to-action conversion function that will help learners by allowing them to input information and watch it translated into equivalent sign language actions or expressions. The addition of multi-language support, which enables users from various linguistic backgrounds to access the system and learn sign language in their original language, is another crucial future project. Additionally, by incorporating speech output functionality, learners with diverse preferences will be catered to by providing audio feedback and help. This will make the system more usable and effective by fostering an inclusive

learning environment that can accommodate a wider spectrum of users.

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