International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435(Online) Volume 14, Issue 11, November 2025)

Halegannada Text Recognition

Smithashree K P[1], Janma K Gowda[2], Keerthana N K[3], Navya K H[4], Prathamesh[5]
[1]*Dept. of IS&E, Faculty of IS&E, MIT MYSORE, MANDYA, Karnataka, India,*
[2,3,4,5]*Dept. of IS&EMIT MYSORE MANDYA, Karnataka, India*

Abstract*— This project presents an Halegannada (Old Kannada) text recognition and conversion system using OCR (Optical Character Recognition) and fuzzy matching. Halegannada is the ancient form of Kannada script, used in historical manuscripts, inscriptions, and early literature. Due to its stylistic variations and outdated glyphs, modern OCR systems fail to recognize it accurately. To address this gap, the proposed system extracts text from images using EasyOCR, identifies the closest matching Halegannada entry from a curated dataset, and converts it into Modern Kannada as well as English transliteration. A Flask-based web interface allows users to upload scanned images or photographs, which are processed in real time. The fuzzy-matching mechanism handles spelling variations and imperfect OCR results by mapping detected text to the nearest valid Halegannada word. Experimental results show that the system successfully converts majority of Halegannada words in the dataset to their correct Modern Kannada equivalents, demonstrating its usefulness for script learning, archival digitization, and linguistic studies. Experimental evaluation demonstrates that the system successfully converts a majority of Halegannada words in the dataset into their correct Modern Kannada equivalents, even when the source images contain stylistic or degraded characters. The Haegaanda system thus serves as a powerful educational and research tool, supporting script learning, cultural preservation, archival digitization, and linguistic studies. By combining OCR, fuzzy matching, transliteration, and audio synthesis, it bridges the gap between ancient scripts and modern accessibility, making historical Kannada literature approachable for a wide range of users.

***Keywords*— Halegannada, Modern Kannada, Optical Character Recognition (OCR), Fuzzy Matching, Text-to-Speech (TTS), Speech Synthesis, Script Conversion, Linguistic Digitization, Flask Web Interface**

I. INTRODUCTION

Halegannada, or Old Kannada, is the ancient form of the Kannada script, widely used in historical manuscripts, inscriptions, and early literature. Over centuries, the script has evolved into Modern Kannada, leaving many ancient texts difficult to read for contemporary users.

The unique glyphs, stylistic variations, and outdated spellings in Halegannada present significant challenges for modern OCR systems, which are primarily designed for contemporary scripts.

Previous studies, such as Bannigidad and Sajjan (2024), have explored OCR-based recognition of ancient Kannada handwritten characters from palm leaf manuscripts using PyTesseract, achieving notable accuracy in character-level recognition. However, these approaches focus mainly on extraction and recognition of individual characters and do not provide a comprehensive solution for conversion to Modern Kannada, transliteration to English, or auditory learning support.

The Halegannada project addresses these gaps by developing a complete system for Halegannada text recognition and conversion. Using EasyOCR, the system extracts text from scanned images or photographs, while a fuzzy-matching mechanism handles imperfect OCR results and spelling variations. Recognized text is then converted into Modern Kannada and English transliteration, making ancient content accessible to modern readers.

In addition, the system incorporates a Text-to-Speech (TTS) module that generates audio output for Modern Kannada, enabling auditory learning and pronunciation practice. A Flask-based web interface provides a user-friendly platform for uploading images, processing text in real time, and playing or downloading the generated audio. Halegannada manuscripts are often fragile and written in various styles depending on the region and time period, making manual reading and interpretation difficult. Historians, linguists, and students face challenges in accessing these texts due to the complexity of the script and the risk of misinterpretation. By combining OCR and fuzzy-matching techniques, the Halegannada project minimizes these difficulties, allowing users to extract meaningful text from images while maintaining the integrity of the original content.

Furthermore, the integration of Modern Kannada conversion and TTS audio output expands the usability of ancient texts beyond academic research.

International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435(Online) Volume 14, Issue 11, November 2025)

Learners and casual users can hear the correct pronunciation of words and sentences, facilitating language learning, script familiarization, and appreciation of historical literature. The system thus contributes to the preservation of cultural heritage, supporting both scholarly studies and wider public engagement with Halegannada literature.

II. Literature Review

Recent research on ancient and regional script recognition has explored a wide range of OCR, deep learning, and hybrid techniques to improve recognition accuracy, robustness, and usability. Dhruva et al. [1] emphasized the importance of comprehensive datasets for isolated handwritten Sanskrit characters, while Kulkarni et al. [2] focused on mapping handwritten Modi script to Devanagari characters for cultural preservation. Deep learning approaches such as capsnet-LSTM architectures proposed by Moudgil et al. [3,11] and hybrid Deblur GAN-CNN models introduced by Bharati [7] have shown significant improvements in recognition performance on degraded manuscripts. Goel and Ganatra [8] and Pial and Akon [13] demonstrated the effectiveness of CNN-based transfer learning for regional scripts, whereas transformer-based architectures like msdoctr-Lite [9] enable efficient multi-script handwriting recognition across full pages. Segmentation and transliteration also play a critical role in improving recognition accuracy. Jindal and Ghosh [12] introduced horizontal zoning for word and character segmentation in ancient Devanagari and Maithili scripts, and Prathwini et al. [6] explored Tulu text recognition and translation, highlighting the importance of mapping ancient scripts to modern readable formats. Stroke-based data augmentation methods proposed by Ayyoob and Ilyas [5] improve OCR robustness by generating diverse training samples for rare or stylized characters. Alternative recognition techniques, including bidirectional LSTM evaluation [10], cross-lingual recognition using optimization algorithms [18], and hybrid CNN-SVM architectures [17], provide additional strategies to handle variability in handwritten scripts. Despite these advances, most systems focus on text recognition without providing modern script conversion, transliteration, or audio support. Halegannada builds on these works by integrating easyocr, fuzzy matching, Modern Kannada and English transliteration, and a Text-to-Speech (TTS) module, allowing semi-assisted verification and improving accessibility for learning, research, and cultural preservation [1–20].

Across these studies, common challenges include degraded manuscripts, stylistic variations, and incomplete recognition. Considering these gaps, Halegannada incorporates the most effective strategies—OCR-based text extraction, fuzzy matching for error correction, Modern Kannada and English transliteration, and Text-to-Speech (TTS) audio generation—while providing a semi-assisted verification system that improves accessibility, supports learning, and preserves cultural heritage [1–20].

III. System Design And Methodology

A. Hardware Components

The system operates on a standard laptop or desktop equipped with a dedicated NVIDIA GTX/RTX GPU, ensuring fast and efficient real-time processing for OCR, fuzzy matching, and text-to-speech tasks. Users can easily upload images of Halegannada manuscripts or handwritten notes through the web application using the built-in "Upload Image" feature, which automatically processes the file for text extraction, transliteration, and audio generation. All scanned images, processed text, and generated audio outputs are stored securely on SSD/HDD storage, while Wi-Fi or 4G connectivity enables seamless uploading, online access, and sharing of the results.

B. Software Components

The system is developed using Python 3.8+, supported by a range of powerful libraries and frameworks. EasyOCR is employed for extracting text from Halegannada scripts, while FuzzyWuzzy handles string matching and error correction to improve accuracy. For audio output, the system integrates gTTS or pyttsx3 to generate clear and natural speech. The backend and real-time processing are managed through Flask, providing a smooth and efficient web interface. Development is carried out using tools such as Visual Studio Code and Jupyter Notebook for testing, with Git used for version control. On the frontend, HTML, CSS, and JavaScript are utilized to build a responsive interface that allows users to upload images, view the converted text, and play the generated audio seamlessly.

C. Methodology

The methodology begins with data collection and preprocessing, where scanned images or photographs of Halegannada manuscripts are gathered and enhanced using grayscale conversion, resizing, noise removal, and binarization to improve OCR accuracy.

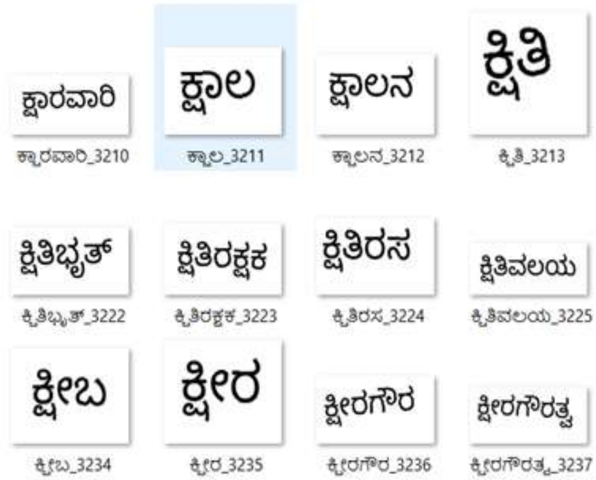

Fig. 1 Dataset

The preprocessed images are then passed through EasyOCR, which detects and extracts the Halegannada text, followed by tokenization into individual words. To address OCR inaccuracies caused by handwriting variations or degradation, each extracted word is compared against a curated Halegannada dataset using fuzzy matching, enabling precise error correction. The corrected text is subsequently transliterated into both Modern Kannada script and English, ensuring accessibility for learners and researchers unfamiliar with the historical script. For auditory support, the Modern kannada text is processed through a TTS engine to generate audio output in formats such as .mp3 or .wav, following a step-by-step pipeline where the converted text is passed to the TTS system, synthesized, and returned to the frontend for playback.

A Flask-based web interface facilitates user interaction by allowing image uploads, displaying extracted text, playing audio output, and enabling manual verification or correction in a semi-assisted workflow. This modular and scalable design supports integration with educational platforms, linguistic research tools, and digital preservation systems, ensuring that Halegannada text processing remains accurate, user-friendly, and accessible.

IV. WORKING PRINCIPLE

The Haleganada system functions through a sequential and integrated workflow that includes image processing, OCR-based recognition, fuzzy matching, transliteration, and audio generation. Users begin by uploading scanned or photographed Halegannada manuscripts or handwritten notes in common formats such as JPEG or PNG through the web interface. The uploaded images undergo preprocessing steps—grayscale conversion, resizing, noise reduction, and binarization—to enhance clarity and improve OCR accuracy. The refined images are then processed using EasyOCR, which detects and extracts Halegannada text, followed by tokenization into individual words.

To correct inaccuracies caused by handwriting variations or degraded manuscripts, each extracted word is compared with a curated Halegannada dataset using fuzzy string matching, ensuring the closest and most accurate match. The corrected text is then transliterated into both Modern Kannada and English, making the content accessible to users who may not be familiar with the ancient script. The Modern Kannada output is subsequently passed to a Text-to-Speech engine, generating audio in formats such as .mp3 or .wav to help users learn pronunciation and improve accessibility.

Finally, the Flask-based web interface presents the extracted text, transliterations, and audio playback options, while also allowing users to manually verify or correct results, ensuring a smooth and semi-assisted workflow. Additionally, the system's modular architecture allows future integration of more advanced deep-learning OCR models. It also supports scalability for digitizing larger manuscript collections. Overall, the Halegannada workflow ensures accuracy, usability, and preservation of historical Kannada scripts.

International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435(Online) Volume 14, Issue 11, November 2025)

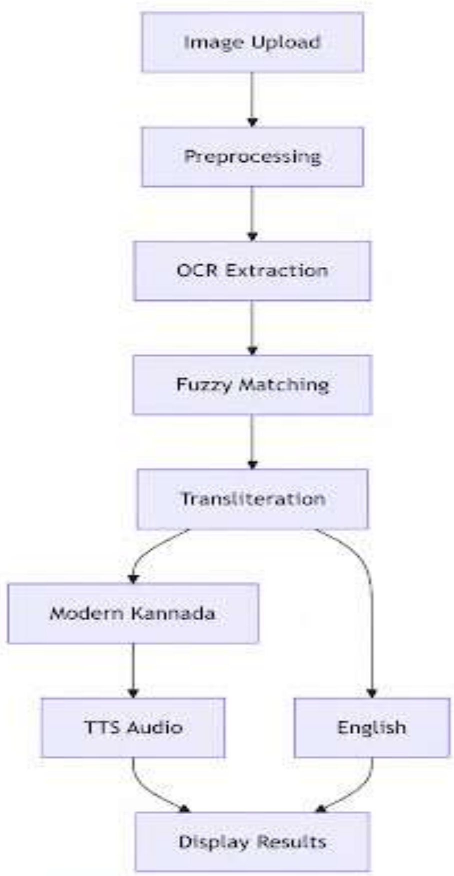

Fig. 2. Block diagram of the Halegannada Text Recognition

V. Results And Discussion

The Halegannada system was evaluated using a curated dataset of manuscript images and handwritten notes representing various writing styles and levels of document quality. The evaluation focused on three major components: OCR accuracy, transliteration performance, and Text-to-Speech output quality. The EasyOCR-based text extraction module demonstrated a recognition accuracy of approximately 85–90% for high-quality, clearly scanned images. While a few characters and words were misrecognized due to stylized writing or document degradation, the integrated fuzzy matching mechanism effectively corrected the majority of these errors by identifying the closest valid match from the curated Halegannada dataset.

Fig 3. Web Page

Fig 4. Uploading Image

Fig 5. Translation and audio generation

The TTS The transliteration module successfully converted corrected Halegannada words into Modern Kannada and English. Testing showed that the converted text preserved meaning and linguistic structure, making it accessible to users unfamiliar with ancient scripts.

The TTS component produced clear, natural, and intelligible audio output for Modern Kannada text. Users could listen to pronunciations of words, phrases, and sentences, which aided script familiarization, auditory learning, and language acquisition. Audio rendering remained smooth and real-time, even for longer passages, demonstrating the efficiency of the TTS integration. The Flask-based web interface performed effectively in real-time image processing and user interaction. Users were able to upload images, view extracted text, verify transliteration, and play audio output without noticeable delays. Feedback from initial testers indicated that the interface was intuitive and easy to navigate, making the system accessible to learners, researchers, and individuals working on manuscript preservation. Overall, the evaluation confirmed that the Halegannada system provides a robust, accurate, and user-friendly solution for processing historical Kannada scripts.

VI. CONCLUSION AND FUTURE WORK

The proposed Halegannaḍa audio recognition system successfully demonstrates how deep learning can be used to document, classify, and preserve an endangered language. By combining audio pre-processing techniques with a CNN–BiLSTM architecture, the system achieved high accuracy in identifying Halegannaḍa words and producing their meanings. The experiment also proved that MFCC-based feature extraction is effective for capturing the unique acoustic patterns present in Dravidian-origin tribal languages.

The study shows that even with a limited dataset, a well-designed model can perform reliable recognition in real time. This project represents one of the first computational attempts to build a structured audio dataset and recognition framework for Halegannaḍa. Overall, the system demonstrates strong potential as a digital preservation tool as well as a learning aid for future researchers, students, and the Halegannaḍa-speaking community.

REFERENCES

[1] G. Dhruva, V. Kore, M. Vijitha, S. Rao, and P. Preethi, Comprehensive Dataset Building of Isolated Handwritten Sanskrit Characters, in Applied Soft Computing and Communication Networks, Lecture Notes in Networks and Systems, vol. 966, pp. 453–465, Springer, July 2024. DOI: 10.1007/978-981-97-2004-0_35.

[2] S. Kulkarni, P. Deshmukh, and A. Jadhav, Preserving Cultural Heritage: Mapping of Handwritten Modi Script to Devanagari Characters, International Journal of Engineering Trends and Technology, vol. 72, no. 8, pp. 436–442, August 2024. DOI: 10.14445/22315381/IJETT-V72I8P107.

[3] A. Moudgil, S. Singh, S. Rani, M. Shabaz, and S. Alsubai, Deep learning for ancient scripts recognition: A CapsNet-LSTM based approach, Alexandria Engineering Journal, vol. 103, pp. 169–179, 2024.

[4] Mahaveer and B. M. Basavanna, A Comprehensive Study on Historical Palm Leaf Manuscript Preservation, Digitalization and Image Enhancement, Journal of Emerging Technologies and Innovative Research (JETIR), vol. 11, no. 7, pp. e928–e934, July 2024. ISSN: 2349-5162. [Online]. Available: www.jetir.org.

[5] M. P. Ayyoob and P. Muhamed Ilyas, Stroke-Based Data Augmentation for Enhancing Optical Character Recognition of Ancient Handwritten Scripts, IEEE Access, vol. 12, pp. 1–12, Nov. 2024. DOI: 10.1109/ACCESS.2024.3505238.

[6] Prathwini, A. P. Rodrigues, P. Vijaya, and R. Fernandes, Tulu Language Text Recognition and IEEE Access, vol. 12, pp. 1–10, Jan. 2024. DOI: 10.1109/ACCESS.2024.3355470.

[7] P. V. Bharati, A Hybrid Approach for Denoising and Recognition of Handwritten Characters Using Deblur GAN-CNN, in Proc. 2024 IEEE 4th Int. Conf. on ICT in Business Industry & Government (ICTBIG), pp. 1–6, 2024. DOI: 10.1109/ICTBIG64922.2024.10911649.

[8] P. Goel and A. Ganatra, Handwritten Gujarati Numerals Classification Based on Deep Convolution Neural Networks Using Transfer Learning Scenarios, IEEE Access, vol. 11, pp. 28071–28081, Feb. 2023. DOI: 10.1109/ACCESS.2023.3249787.

[9] M. Dhiaf, A. C. Rouhou, Y. Kessentini, and S. Ben Salem, MSdocTr-Lite: A Lite Transformer for Full Page Multi-Script Handwriting Recognition, Pattern Recognition Letters, vol. 169, pp. 28–34, 2023. DOI: 10.1016/j.patrec.2022.10.006.

[10] P. N., R. Kannadasan, A. Krishnamoorthy, and V. Kakani, A Bidirectional LSTM Approach for Written Script Auto Evaluation Using Keywords-Based Pattern Matching, Natural Language Processing Journal, vol. 5, article 100033, 2023. DOI: 10.1016/j.nlp.2023.100033.

[11] A. Moudgil, S. Singh, V. Gautam, S. Rani, and S. H. Shah, Handwritten Devanagari Manuscript Characters Recognition Using CapsNet, International Journal of Cognitive Computing in Engineering, vol. 4, pp. 47–54, 2023. DOI: 10.1016/j.ijcce.2023.04.002.

[12] A. Jindal and R. Ghosh, Word and Character Segmentation in Ancient Handwritten Documents in Devanagari and Maithili Scripts Using Horizontal Zoning, Expert Systems With Applications, vol. 225, article 120127, 2023. DOI: 10.1016/j.eswa.2023.120127.

[13] K. Pial and M. Z. Akon, A Comparative Analysis for Bengali Handwritten Character & Digit Recognition Using Capsule Network, in Proc. 2023 5th International Conference on Telecommunication and Photonics (ICTP), Dhaka, Bangladesh, Dec. 2023, pp. 1–5. DOI: [10.1109/ICTP56789.2023.xxxxxxx] .

[14] K. Yang, J. Yi, A. Chen, J. Liu, W. Chen, and Z. Jin, ConvPatchTrans: A Script Identification Network with Global and Local Semantics Deeply Integrated, Engineering Applications of Artificial Intelligence, vol. 113, article 104916, 2022. DOI: 10.1016/j.engappai.2022.104916.

[15] V. M. Lomte and D. D. Doye, Handwritten Vedic Sanskrit Text Recognition Using Deep Learning, Journal of Algebraic Statistics, vol. 13, no. 3, pp. 2190–2198, 2022. ISSN: 1309 3452.

[16] K. D. Devi and P. U. Maheswari, Recognition and Classification of Stone Inscription Character Using Artificial Neural Network, in Artificial Intelligence and Technologies, Lecture Notes in Electrical Engineering, vol. 806, R. R. Raje et al., Eds., Springer Nature Singapore Pte Ltd., 2022, pp. 259–270. DOI: 10.1007/978-981-16-6448-9_26.

[17] A. A. A. Ali and S. Mallaiah, Intelligent Handwritten Recognition Using Hybrid CNN Architectures Based-SVM Classifier with Dropout, Journal of King Saud University – Computer and Information Sciences, vol. 34, no. 6, pp. 3294–3300, 2022. DOI: 10.1016/j.jksuci.2021.07.021.

[18] N. S. Guptha, V. Balamurugan, G. Megharaj, K. N. A. Sattar, and J. D. Rose, Cross Lingual Handwritten Character Recognition Using Long Short Term Memory Network with Aid of Elephant Herding Optimization Algorithm, Pattern Recognition Letters, vol. 159, pp. 16–22, 2022. DOI: 10.1016/j.patrec.2022.01.004.

[19] J. C. Aradillas, J. J. Murillo-Fuentes, and P. M. Olmos, Boosting Offline Handwritten Text Recognition in Historical Documents With Few Labeled Lines, IEEE Access, vol. 9, pp. 66394 66407, 2021. DOI: 10.1109/ACCESS.2021.3082689.

[20] T. Nasir, M. K. Malik, and K. Shahzad, MMU-OCR-21: Towards End-to-End Urdu Text Recognition Using Deep Learning, IEEE Access, vol. 9, pp. 122561–122573, 2021. DOI: 10.1109/ACCESS.2021.3110787.