15TH ITU ACADEMIC CONFERENCE

ITU KALEIDOSCOPE
NEW DELHI 2024

Innovation and digital transformation for a sustainable world

21-23 October 2024
New Delhi, India

Alpha-Bit: An Android App for Enhancing Pattern Recognition using CNN and Sequential Deep Learning

23 October 2024

Gobi Ramasamy
Christ University, Bangalore

Session #4.4

Presentation Outline

Alpha-Bit: An Android App for Enhancing Pattern Recognition Using CNN and Sequential Deep Learning

- Introduction
- Motivation and Context
- Related works
- Proposed Methods
- Preprocessing Handwritten Data
- Implementation Framework
- Results and Discussion
- Conclusion
- References

Introduction

- Purpose: Android app to enhance pattern recognition for alphabets and numbers.
- Technology: Uses deep learning models like CNN and Sequential networks.
- Impact: Supports educational accessibility and quality, aligned with SDG 4 (Quality Education).

Motivation and Context

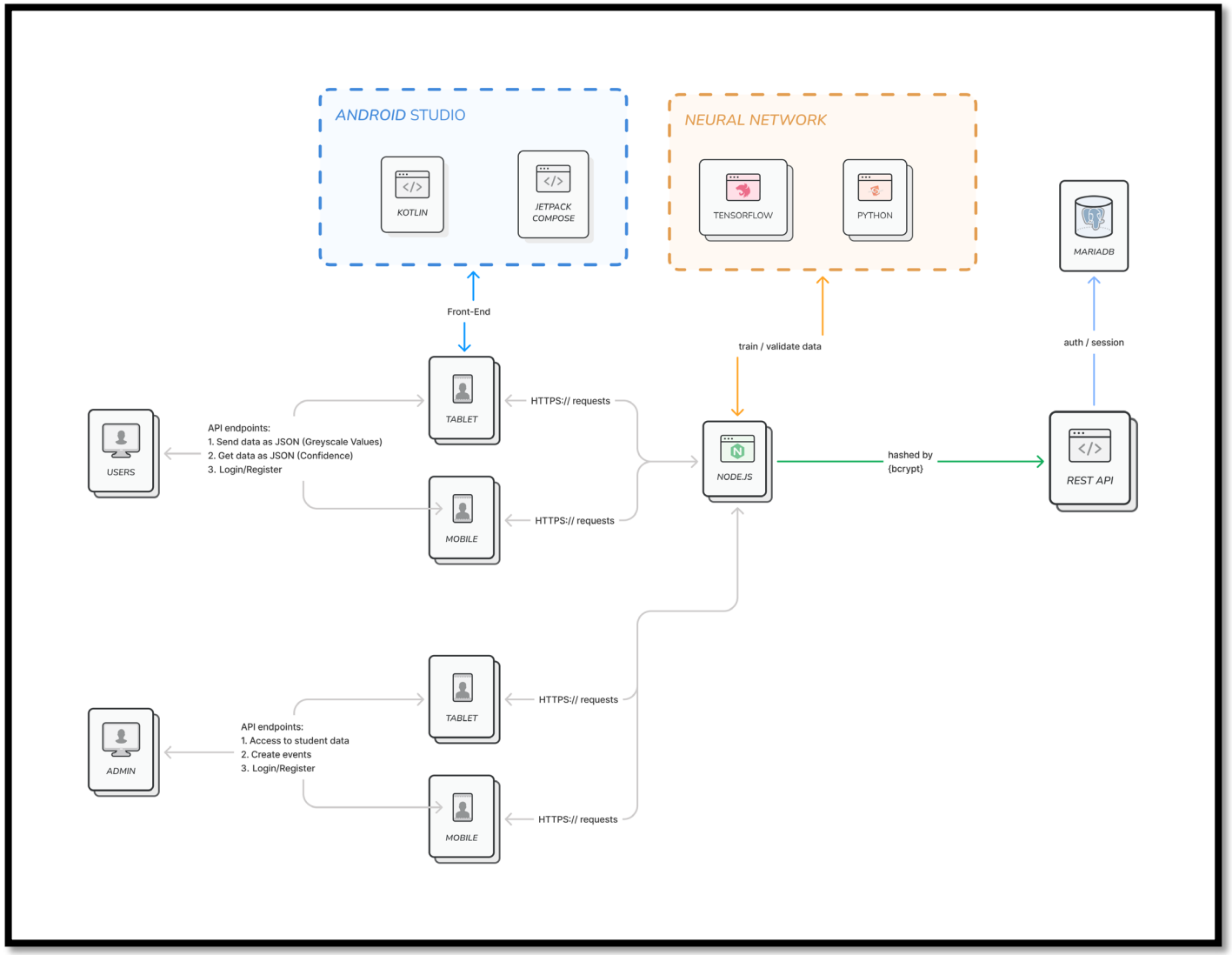
- Educational Inequality: Limited resources affect learning, especially in rural areas.
- Tech Solution: OCR with deep learning to make education accessible on a global scale.

Related Works

- Key Studies Discussed:
  - AI in Early Childhood Education
  - The Impact of Smartphones on Learning Effectiveness
  - Teaching Mathematics via Mobile Devices in Kindergarten
  - Backpropagation for Handwritten Recognition by LeCun et al.

- Research Gap: Few applications tailored for early literacy education using deep learning.

Proposed Methods



- **Frontend:** The user interface is built using web app development technologies, ensuring a user-friendly experience for children and parents.
- **Backend:** Alpha-Bit's backend relies on a local database architecture to handle data storage, deep learning algorithms, and user analytics. It uses advanced machine learning models to personalize the learning experience for each child.
- **Data Security:** Stringent data security measures are in place to protect children's data and comply with privacy regulations.

Proposed Methods

- Deep Learning Architecture:
  - CNN: For feature extraction of character patterns.
  - Sequential Networks (e.g., LSTM): For handling the sequence of characters in language learning.

- Innovative Features: Guided instruction and personalized progress tracking.

Proposed Methods

- Data Preparation Steps:
  - Load and format EMNIST dataset.
  - Image resizing, normalization, and augmentation.
  - Label encoding for compatibility with the model.

- Importance: Ensures data is ready for efficient feature extraction and accurate recognition.

Pre-processing Handwritten Data

- The preprocessing of handwritten data from the Extended Modified National Institute of Standards and Technology (EMNIST) dataset for OCR within the context of the Alpha-Bit research paper necessitates a nuanced approach encompassing advanced methodologies.
- A robust foundation for the subsequent stages of the OCR pipeline.
    - Data Loading and Formatting
    - Image Resizing and Normalization
    - Data Augmentation
    - Label Encoding
    - Feature Extraction with CNN
    - Sequential Modeling
    - Data Splitting

Implementation Framework

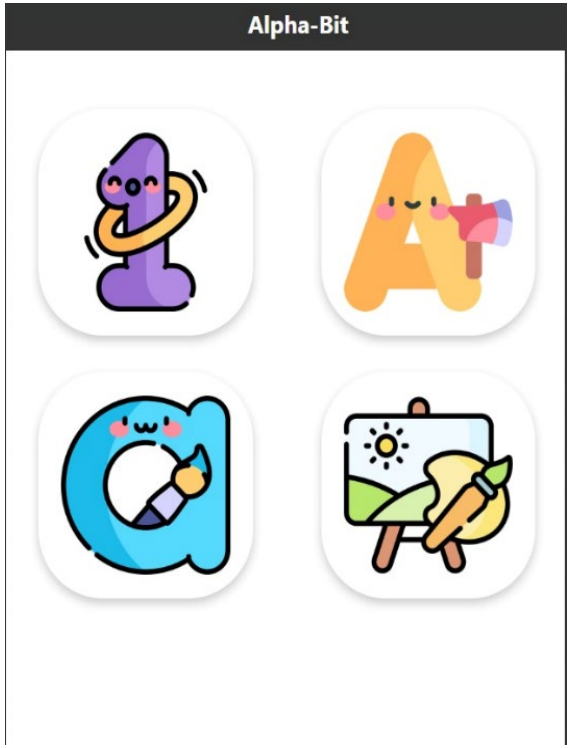
- Technical Tools:
  - CNNs: Backbone for OCR accuracy and feature extraction.
  - OpenCV & TensorFlow Lite: Integrated for image processing and on-device machine learning.

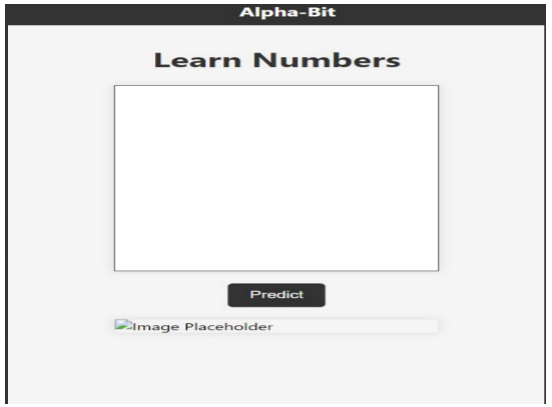
- Application Development: Built using Android Studio with TensorFlow Lite model integration.

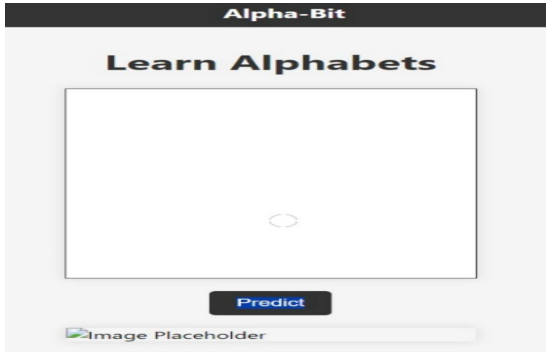
Implementation Framework

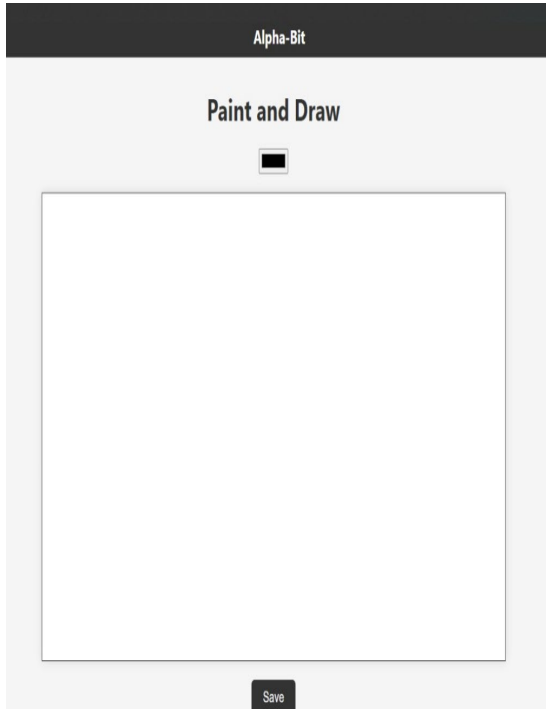
- Android Development Tools
  - Android Studio
- Cloud Services
  - MariaDB
  - NodeJS
- Deep Learning Libraries
  - Keras
  - TensorFlow
  - PyTorch

App Screenshots

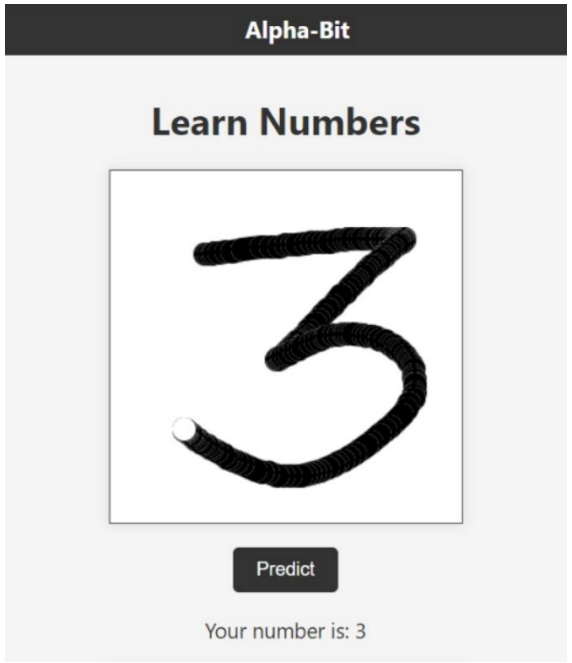


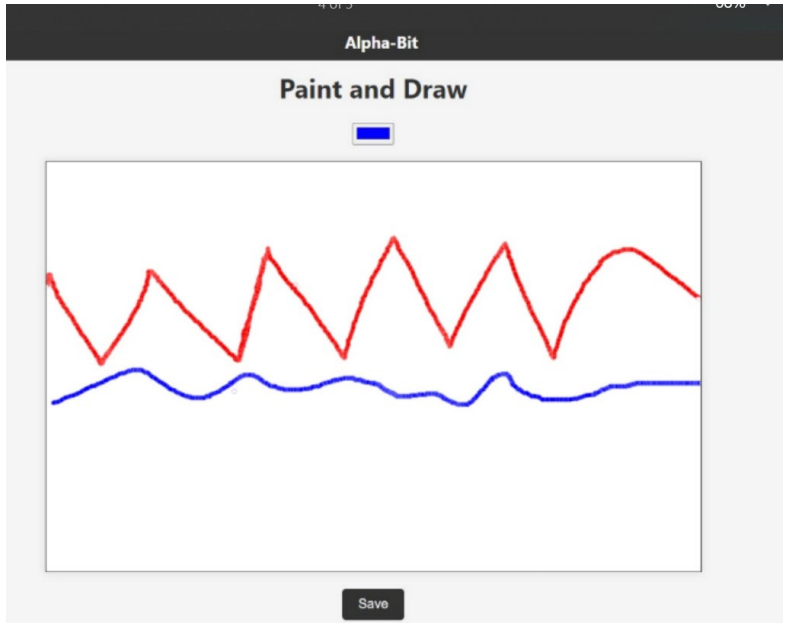


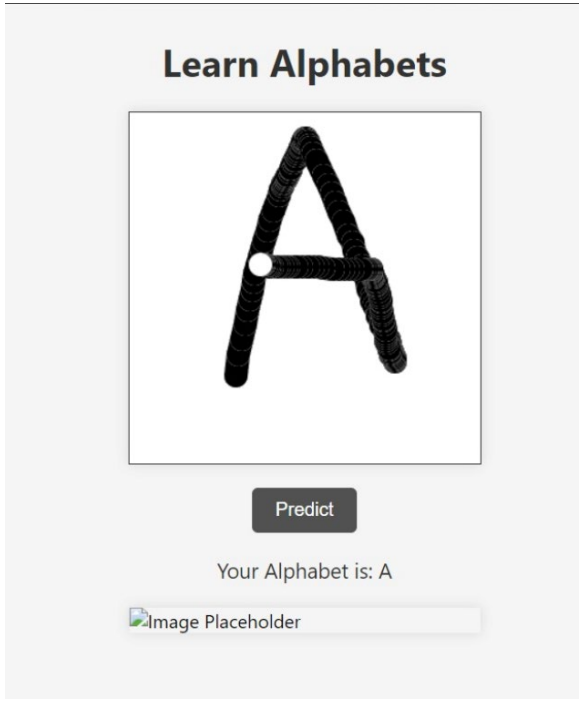




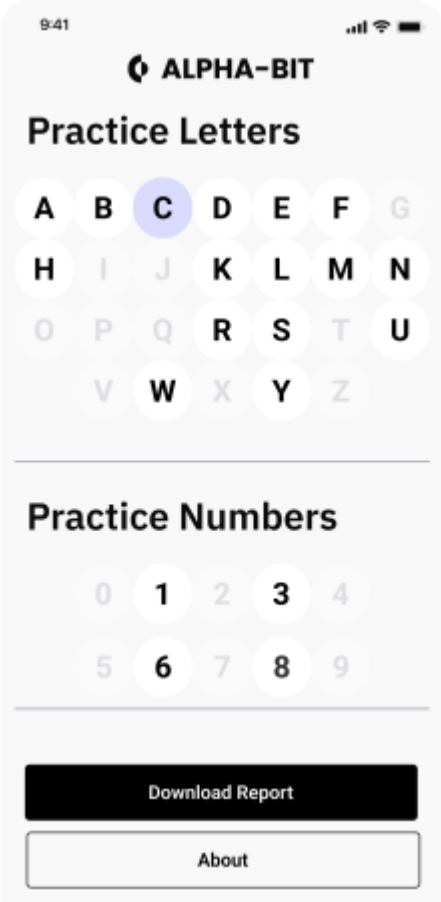
App Screenshots

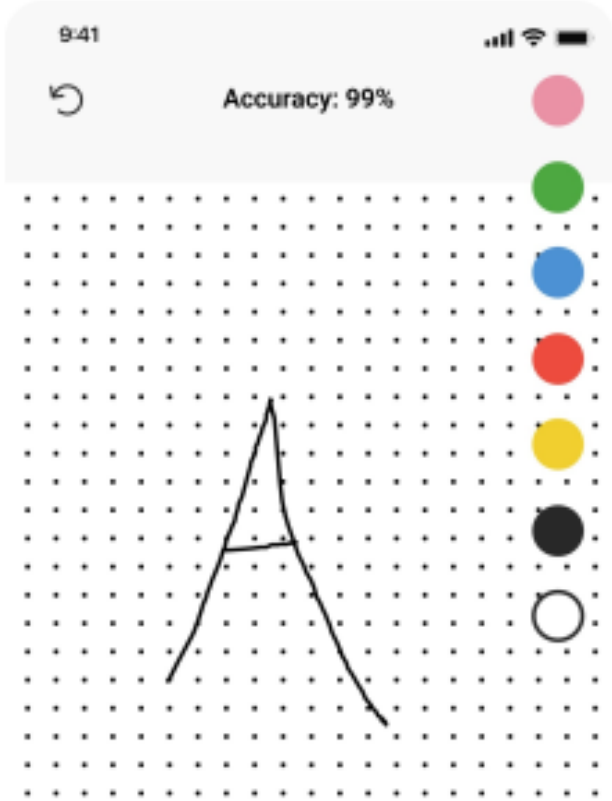






App Screenshots





Results and Discussion

- Technical Tools:
  - CNNs: Backbone for OCR accuracy and feature extraction.
  - OpenCV & TensorFlow Lite: Integrated for image processing and on-device machine learning.

- Application Development: Built using Android Studio with TensorFlow Lite model integration.

Conclusion

- Impact of Alpha-Bit:
  - Advances SDG 4 by providing quality education tools.
  - Reduces educational inequalities through accessible technology.

- Future Potential: Expansion to include more languages and adaptive learning features.

References

[1] Y. LeCun et al., ”Backpropagation Applied to Handwritten Zip Code Recognition,” Neural Computation, 1989.

[2] A. Graves et al., ”A novel connectionist system for unconstrained handwriting recognition,” IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 31, no. 5, 2009.

[3] T. Qiao et al., ”Seed: Semantics enhanced encoder-decoder framework for scene text recognition,” in Proceedings of the IEEE/CVF Conferenceon Computer Vision and Pattern Recognition, 2020, pp. 13528-13537.

[4] Z. Wan et al., ”Tencent ML-Images: A Large-Scale Multi-Label Image Database for Visual Representation Learning,” IEEE Access, vol. 7, pp. 172683-172693, 2019.

[5] N. Sharma et al., ”Multilingual OCR for Resource-Scarce Languages using Deep Learning,” in 2019 International Conference on Document Analysis and Recognition (ICDAR), 2019, pp. 1055-1062.

[6] J. Su and W. Yang, “Artificial intelligence in early childhood education: A scoping review,” Computers & Education, vol. 160, p. 104025, 2020.

[7] S. Papadakis, M. Kalogiannakis, and N. Zaranis, “Teaching mathematics with mobile devices and the Realistic Mathematical Education (RME) approach in kindergarten,” International Journal of Mobile Learning and Organisation, vol. 13, no. 2, pp. 255-277, 2019.

[8] J. C. Wang, C. Y. Hsieh, and S. H. Kung, “The impact of smartphone use on learning effectiveness: A case study of primary school students,” in Proceedings of the International Conference on E-Learning in the Workplace (ICELW), New York, NY, USA, 2018, pp. 187–195.

Thank you!