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Atlantic Technological University

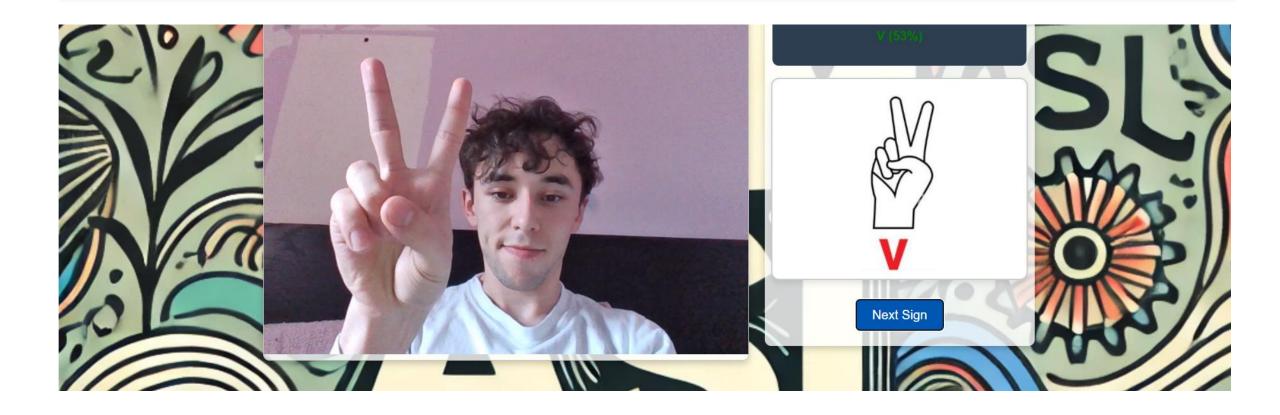
CAMASL Camera-Assisted Machine Learning for American Sign Language

Final Year Project – Sean Conroy

Bachelor of Engineering (Hons) – Atlantic
Technological University

Project Overview

- •Goal: Real-time ASL learning platform using only a webcam
- •Problem: Lack of interactive, accessible ASL tools
- •Solution: ML-based gesture recognition through a web application



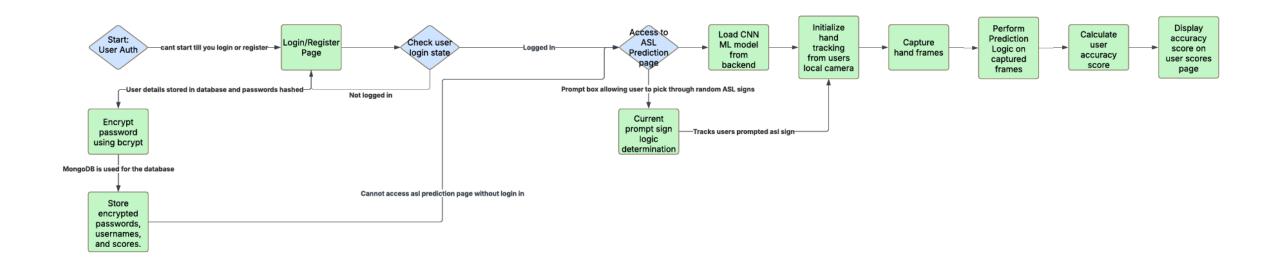
System Architecture Overview

•Frontend: React

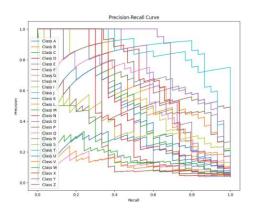
Backend: FastAPI + TensorFlow

•Hand Tracking: MediaPipe

Database: MongoDB Atlas



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Epoch 2/35															
450/450		1745	355ms/step	- acci	arecy:	0.9375	- 1055	0.2213	- val.accura	y: 0.975	vel_loss:	0.1043	- le	arming rate:	9.8987e-05
Epoch 3/25															
450/450		1831	374ms/step	- 8001	PRCY:	0.9758	- less	0.0075	- val_accura	y: 0.597;	vel_loss:	0.0240	- le	erning_rate:	9.4632e-05
Epoch 4/35															
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Epoch 5/25															
450/450		1904	352ms/step	- acci	recy:	0.9925	- 1055	0.0343	- val_accura	:y: 0.996	vel_loss:	0.0009	- 20	arming_rate:	7.1435e-05
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Epoch 11/25															
450/450 -									- val_accura						2.5888e-87

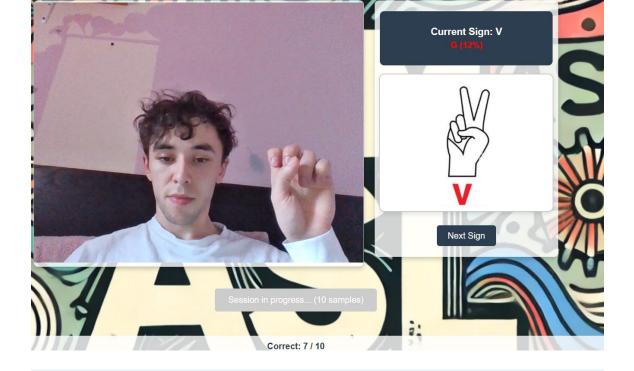
Total params: 2,257,984 (8.61 MB)
Trainable params: 2,223,872 (8.48 MB)
Non-trainable params: 34,112 (133.25 KB)

Machine Learning Model

- MobileNetV2 fine-tuned for ASL gestures
- •Lightweight, fast inference
- •Metrics: Accuracy, Precision, Recall, F1-score

How the Application Works

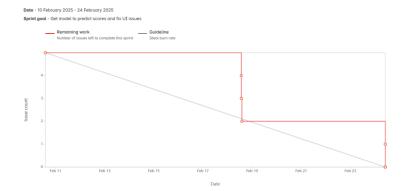
- User login
- Random sign prompt displayed
- Webcam frame sent to backend
- Hand detection → Model prediction → Scoring over 30 frames

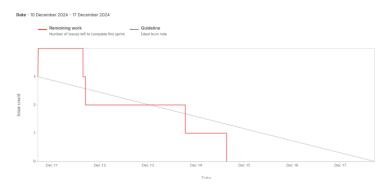


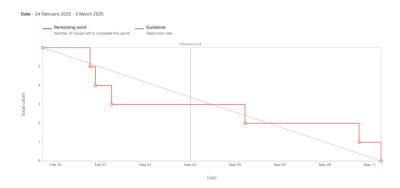


Project Management

- Agile Methodology
- •Two-week sprints
- •Jira for tracking tasks and progress













Key Technologies and Libraries

- React, FastAPI, TensorFlow, MediaPipe
- MongoDB
- Tools: GitHub, Google Colab, VS Code





Challenges and Solutions

- •TensorFlow.js issues → Moved inference server-side
- •Class imbalances in dataset
- •Real-time performance optimizations
- •Secure authentication with JWT cookies



Ethical Considerations



Accessibility focus

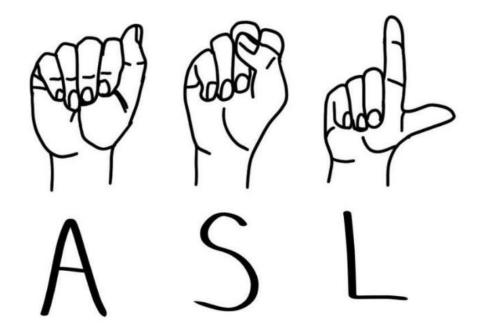


No storage of video/image data



Clear, transparent Al usage





Conclusion

- Real-time ASL learning platform achieved
- Solid foundation for future expansion
- Ready for real-world educational use