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Faculty of Engineering & Informatics

# A Comparative Study of Machine Learning Algorithms for Fingerspelling Recognition

**Chris Pinto [1], Dr. Michael Russell [2]**

[1] Master's Student, MSc in Software Engineering
[2] Supervisor, Department of Computer and Software Engineering

PROJECT REPOSITORY

## Research Question

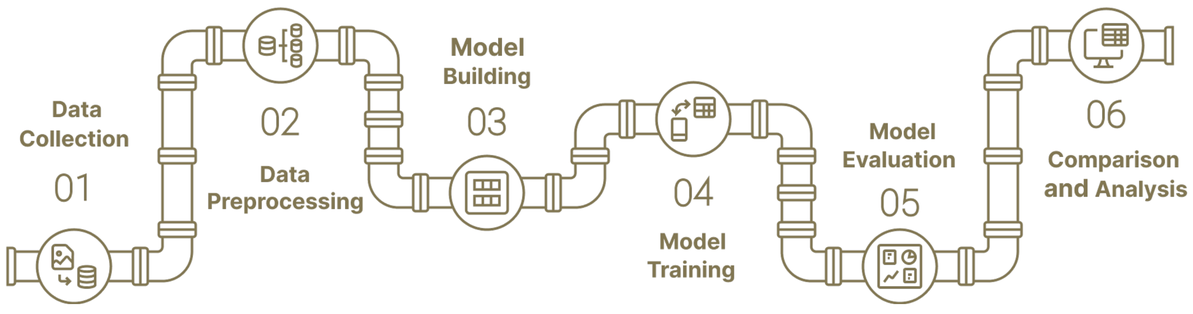
How do different machine learning algorithms compare in key performance metrics (accuracy, precision, recall and F1-score) for fingerspelling recognition?

## Abstract

Fingerspelling recognition is a crucial aspect of sign language interpretation. This study evaluates the accuracy and performance of three machine learning algorithms - Convolutional Neural Networks (CNN), Support Vector Machines (SVM) and MobileNet - in recognising static fingerspelling images.

These models were trained and tested on a publicly available dataset of hand gesture images representing different letters of the alphabet. The results show that deep learning models such as CNN and MobileNet outperform traditional machine learning models such as SVM in terms of accuracy and overall performance.

## Methodology

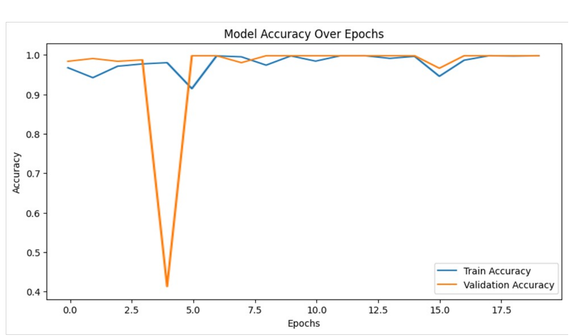



Machine Learning Pipeline for Fingerspelling Recognition

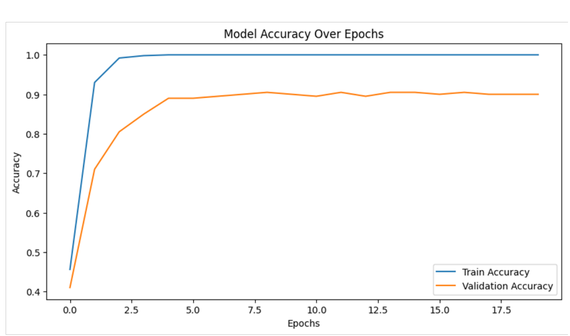
- **Data Collection:** The dataset was publicly available and sourced from Kaggle. It consists of 24 classes and split into training and testing datasets.
- **Data Preprocessing:** Image Resizing, Normalisation, Data Augmentation, Dataset Split (Training, Validation, Testing)
- **Model Building:** Algorithms used: CNN, SVM and MobileNet
- **Hyperparameter Tuning:** Methods such as Hyperband tuning and Bayesian Optimization were used
- **Model Training:** Trained in a GPU environment for faster training
- **Model Evaluation:** Accuracy, Precision, Recall, F1-Score, Confusion Matrix
- **Performance Comparison:** Results compared and plotted in graphs for easy comparisons

## Results

Training vs Validation Performance Graph

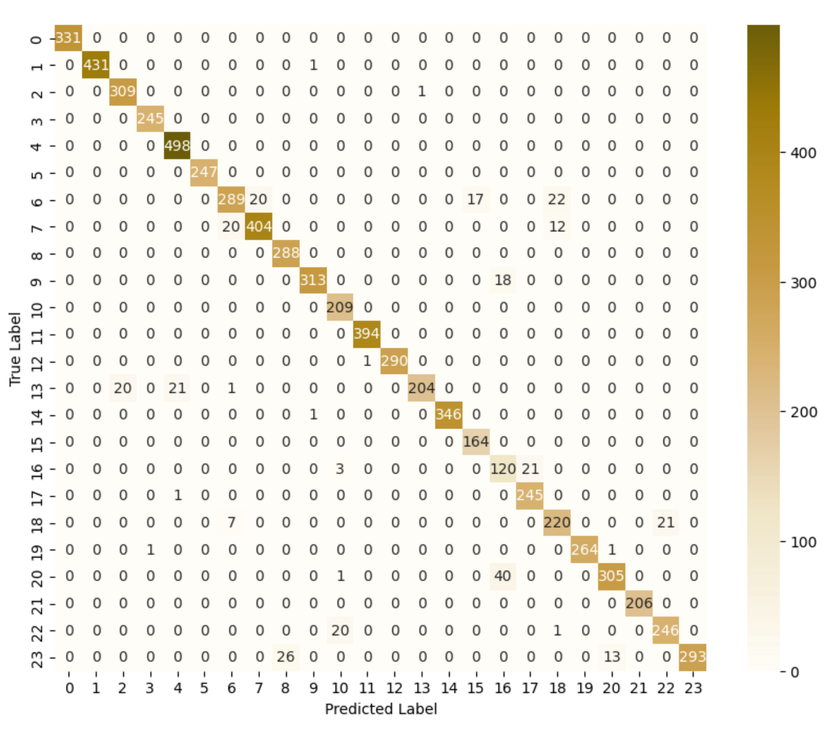



CNN




MobileNet

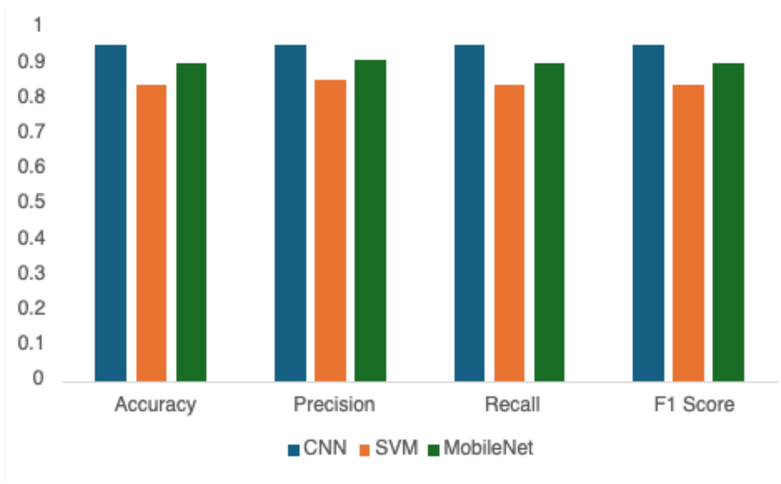
Confusion Matrix for Error Analysis for CNN (Best Performing Model)




Model Performance Comparison

| Model | Accuracy | Precision | Recall | F1 Score |
|---|---|---|---|---|
| CNN | 93% | 93% | 93% | 93% |
| SVM | 83% | 85% | 84% | 84% |
| MobileNet | 91% | 93% | 91% | 91% |

Performance Graph




## Conclusion

This study demonstrates that deep learning models, particularly Convolutional Neural Networks (CNN), offer superior performance in fingerspelling recognition when compared to traditional machine learning models like Support Vector Machines (SVM). The application of hyperparameter tuning further enhanced the models' accuracy, highlighting the importance of optimization in machine learning tasks.

## Future Work

- Continuous Sign Language Recognition
- Multimodal Fusion with Audio or Video Cues
- Improving Dataset Diversity and Quality
- Adaptive Learning Models

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