

Appendix-A

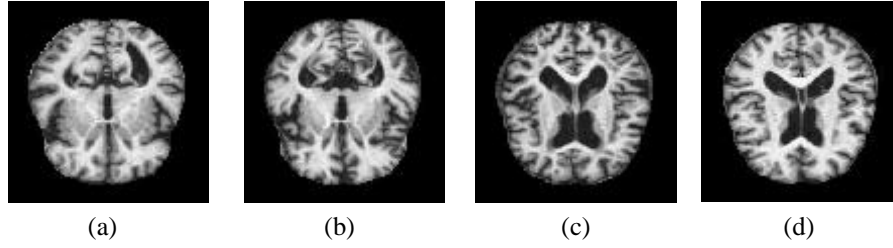


Figure 1 illustrates the stages of Alzheimer's Disease from MRI Scans that were acquired from the Kaggle dataset. (a) Mild Demented (b): Moderate Demented (c): Non-Demented (d) Very Mild-Demented

Table 1 shows the distribution of the MRI dataset before and after applying SMOTE and their classes.

MRI Scans before data augmentation (SMOTE-Tomek)	
Class	No. Images
Mild Demented	896
Moderate Demented	3200
Non-Demented	2240
Very Mild Demented	64
Total	6400
MRI Scans after data augmentation (SMOTE-Tomek)	
Class	No. Images
Mild Demented	2897
Moderate Demented	2897
Non-Demented	2897
Very Mild Demented	2897
Total	11588

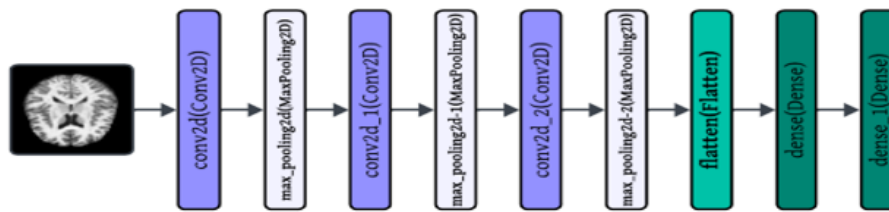


Figure 2 illustrates the proposed CNN base model in this paper for identifying stages of Alzheimer's Disease.

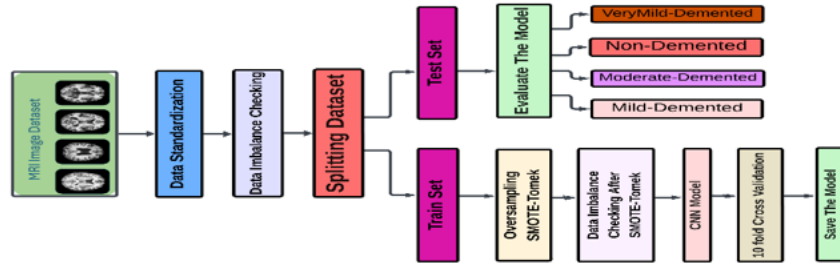
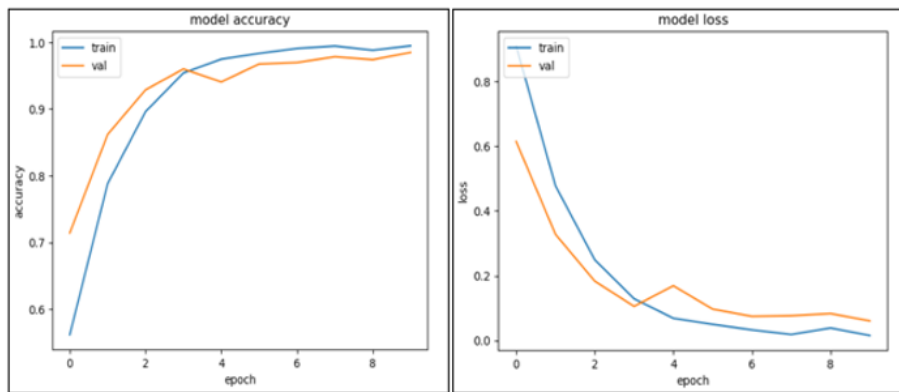


Figure 3 illustrates the workflow in this paper. The acquired MRI scans from Kaggle went through preprocessing, as shown here. The preprocessed data is split into 80% for training and validation and 20% for testing. The CNN base model was developed, as shown in Figure 2. The model was trained and validated on the 80% training set. The best model was saved as a .keras file for evaluation on the test set.



(a) Proposed model's training and validation accuracy curve.

(b) Proposed model's training and validation loss curve

Figure 4 illustrates the training and validation accuracy curve as well as the training and validation loss curve from the 10-fold cross-validation process of the 80% training set of MRI data.

Table 2 illustrates the performance of the proposed CNN-based model compared to the hybrid DL model in the study by Rana et al. [16]

	Class	Precision	Recall	Specificity	Support
Rana et al. (2023)	Cognitive Normal	99.00%	100.00%	100.00%	337
	Very Mild Demented	100.00%	100.00%	100.00%	351
	Mild Demented	95.00%	93.00%	94.00%	274
	Moderate Demented	94.00%	95.00%	95.00%	301
	Micro Avg	97.00%	97.00%	97.00%	1263
	Macro Avg	97.00%	97.00%	97.00%	1263
	Weighted Avg	97.00%	97.00%	97.00%	1263
Propose CNN- based Model	Cognitive Normal	100.00%	98.00%	99.00%	233
	Very Mild Demented	98.00%	100.00%	99.00%	229
	Mild Demented	100.00%	100.00%	100.00%	222
	Moderate Demented	100.00%	100.00%	100.00%	243
	Accuracy			99.00%	927
	Macro Avg	99.00%	99.00%	99.00%	927
	Weighted Avg	99.00%	99.00%	99.00%	927

Table 3 illustrates the performance of the proposed CNN-based model compared to two prominent studies in this research domain.

	Class	Accuracy	Precision	Recall	Specificity	F1-Score
Islam and Zhang [24]	Cognitive Normal	-	99.00%	99.00%	-	99.00%
	Very Mild Demented	-	75.00%	50.00%	-	60.00%
	Mild Demented	-	63.00%	71.00%	-	67.00%
	Moderate Demented	-	33.00%	50.00%	-	40.00%
	Average	-	67.50%	67.50%	-	66.50%
Puente- Castro et al. [25]	Cognitive Normal	80.05%	92.54%	81.25%	78.00%	86.53%
	Very Mild Demented	75.00%	35.77%	70.00%	75.96%	47.34%
	Mild Demented	92.66%	0.00%	0.00%	99.02%	0.00%
	Moderate Demented	99.54%	0.00%	0.00%	100.00%	0.00%
	Average	86.81%	32.08%	37.81%	88.25%	66.50%
Proposed Model	Cognitive Normal	97.71%	97.00%	98.00%	98.97%	97.00%
	Very Mild Demented	96.69%	98.00%	97.00%	99.97%	97.00%
	Mild Demented	100.00%	100.00%	100.00%	99.88%	100.00%
	Moderate Demented	100.00%	100.00%	100.00%	100.00%	100.00%
	Average	98.60%	98.75%	98.75%	99.71%	98.50%