BRAINTECT: Brain Tumour Detection using Convolutional Neural Network (CNN)

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Constance Ooi Le Min [1], Martina Curran[2]

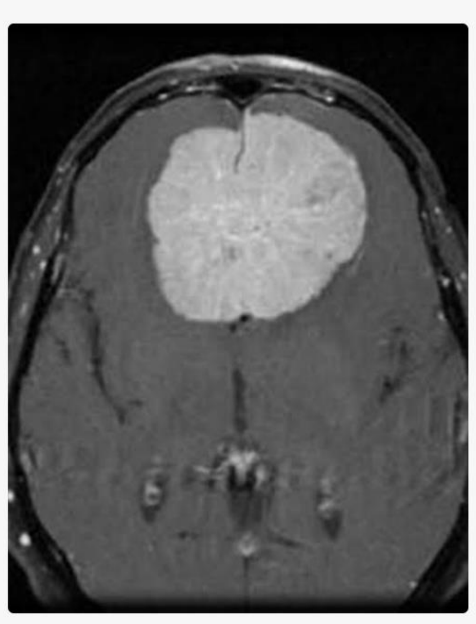
[1] 4th Year Student, BSc(Hons) Software Design with AI for Cloud Computing
[2] Supervisor, Department of Computer and Software Engineering, Technological University of The Shannon: Midlands Midwest

Abstract: A machine learning based web application, BRAINTECT is proposed to assist medical professionals in diagnosing brain tumours using MRI scans. This project utilises a CNN model with EfficientNet-B1 architecture, implemented with Flask, HTML, PostgreSQL, adopting Model-View-Controller design pattern. BRAINTECT covers several types of brain tumours, including No Tumour, Glioma Tumour, Meningioma Tumour, and Pituitary Tumour. The model achieves a high precision, recall, and f1-score, scoring above 97% for all four classes, resulting in an overall accuracy of 98%. Through integrating backend, frontend, database and CNN model, BRAINTECT is developed to enhance brain tumour diagnostic for better patient outcomes.

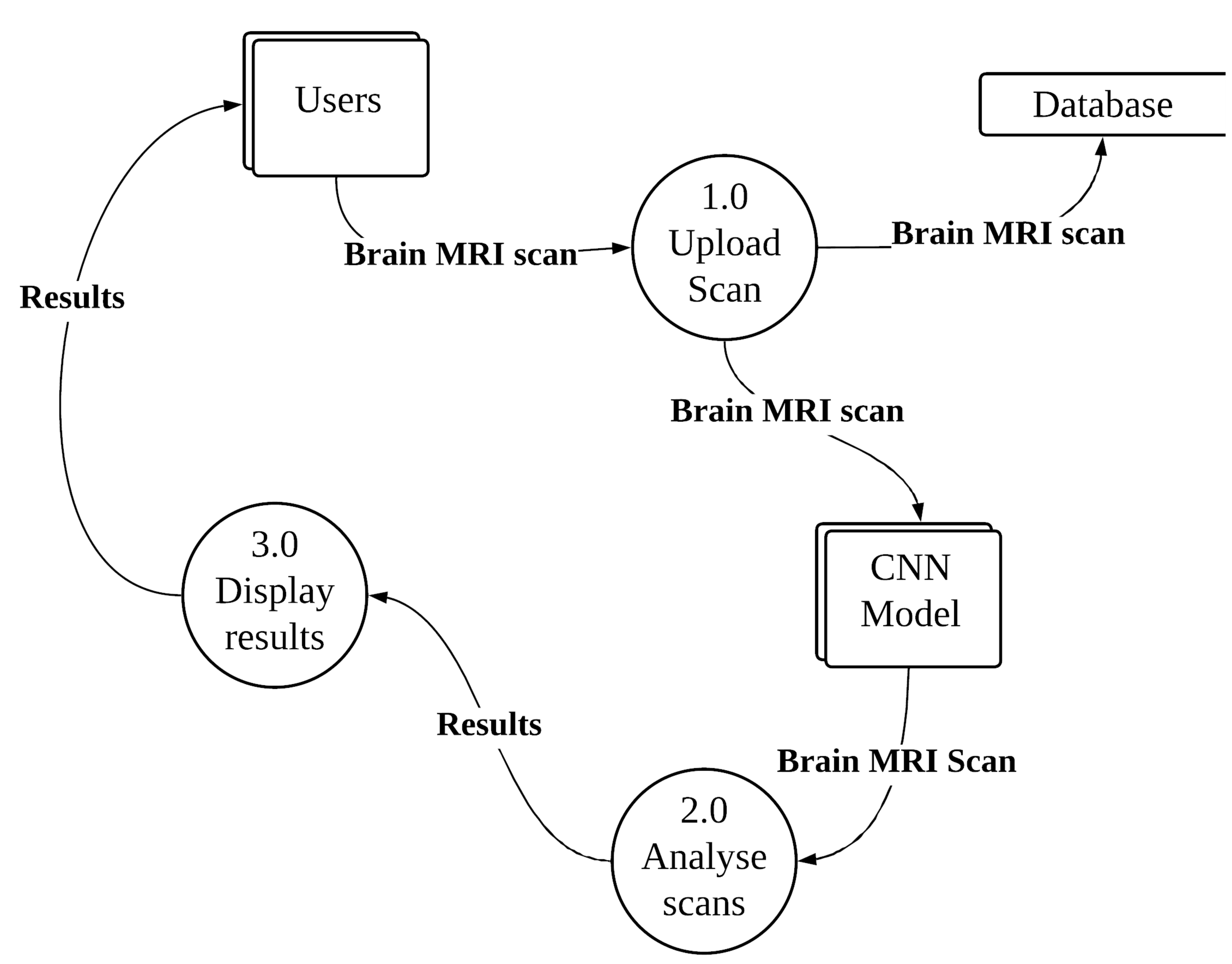
Introduction: Artificial Intelligence brings massive change to all sectors includes healthcare, providing new opportunities for diagnosis. Brain tumours present a serious health risk that requires precise and effective diagnosis for better treatment options. This study present the development of CNN based web application to detect brain tumours from MRI scans. It aims to help medical professionals enhance the speed and accuracy of diagnosis and improve patient outcomes.

Methodology: BRAINTECT is developed using Model-View-Controller design pattern. The system uses Flask, HTML, CSS, JS, and PostgreSQL to create an interface for users to upload MRI scans and view the prediction result. Upon upload, the scans are saved into database and send to the CNN model for analysis, which then returns the prediction results. The CNN model employs EfficientNet-B1 architecture and is trained on dataset from Kaggle, covering No Tumour, Glioma, Meningioma and Pituitary Tumour. Rigorous testing and validation processes are done to ensure the overall performance and reliability of BRAINTECT.

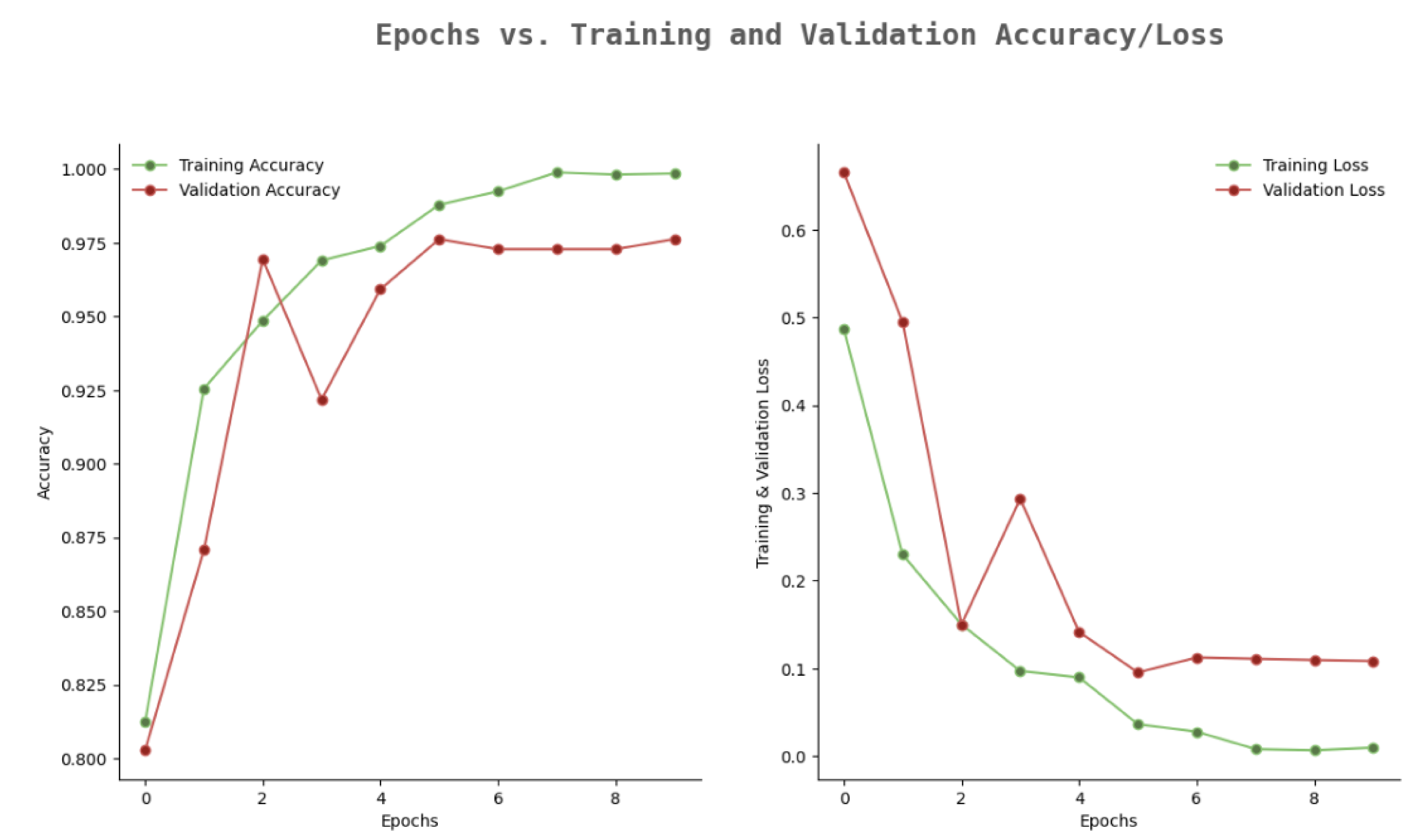
Prediction Result



Result: meningioma_tumor



Results and Discussion: The performance of the model has been evaluated using metrics: precision, recall, f1-score and accuracy. It scores a relatively high values across four classes for all metrics, ranging from 97% to 100%. An accuracy of 98% is achieved which proves the ability of the model in correctly detecting brain tumours. The model shows a steady improvement for validation accuracy across epochs, from 80.2% to 97.6%. The validation loss also gradually decreased that shows the model's ability to generalize. These metrics shows the ability of the model in correctly classify and detect brain tumours through MRI scans.



	precision	recall	f1-score	support
Glioma Tumour (GT) 0	0.99	0.99	0.99	85
Meningioma Tumour (MT) 1	1.00	0.97	0.98	94
No Tumour (NT) 2	0.98	0.98	0.98	53
Pituitary Tumour (PT) 3	0.97	1.00	0.98	95
accuracy			0.98	327
macro avg	0.98	0.98	0.98	327
weighted avg	0.98	0.98	0.98	327

Conclusion: The development of BRAINTECT represents a potential advancement in medical diagnostics. The model's performance has validated, proving its ability and effectiveness in brain tumour detection through metrics such as accuracy. Through the utilization of CNN and advanced technologies, BRAINTECT offers a reliable and effective tool for medical professionals in clinical practices. With the ability of accurate and early diagnosis, BRAINTECT has the potential to enhance the diagnostic process in clinical practices, thus improving patient outcomes and survival rates.

Future Work: BRAINTECT should be continuously refined and expanded to enhance its brain tumour diagnostic capabilities. Future efforts like integrating more advanced and suitable AI techniques, expanding the classification to more brain tumour types, refining the user interface, and conducting rigorous validation test, should be conducted. These efforts can further enhance BRAINTECT's performance, reliability, and usability, ultimately advancing its primary objective.

REFERENCES

[1] A. W. Salehi et al., “A study of CNN and transfer learning in medical imaging: Advantages, challenges, future scope,” Sustainability, vol. 15, no. 7, p. 5930, Mar. 2023. doi:10.3390/su15075930