Brain Tumour Detection with Convolutional Neural Network

AI-Powered Medical Imaging Classification

Diani Patel

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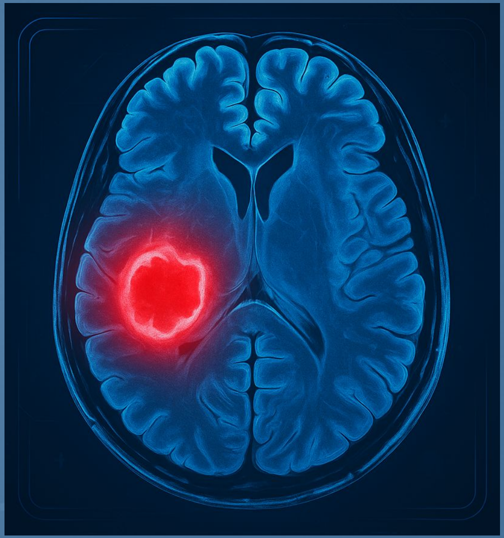
Introduction to AI in Medical Imaging

- AI is revolutionising how medical images (e.g. MRIs, CTs, X-rays) are analysed
- Manual interpretation of high image volumes is time-consuming and resource-heavy
- AI enables:
  - Automated processing
  - Faster diagnosis
  - Improved treatment decisions

Sources: Pinto-Coelho (2023), Kunapuli (2021)

Why Brain Tumours?

- Abnormal growths that may be benign or malignant
- Can impact people of all ages
- Early detection is crucial for successful treatment
- MRI imaging is a standard, non-invasive diagnostic tool



Source: NHS (2023)

Dataset Used

- **Dataset Name:** Brain MRI Images for Brain Tumour Detection
- MRI images divided into:
    - Tumour
    - No Tumour
- Used for model training and testing

Source: Chakrabarty (2019)

Why CNN?

- Convolutional Neural Networks (CNNs) are ideal for medical image tasks
- CNNs consistently perform well in image classification tasks, achieving strong results
- They automatically extract key features like texture, shape, and edge patterns – making them highly effective in tumour detection

Source: Yadav and Jadhav (2019)

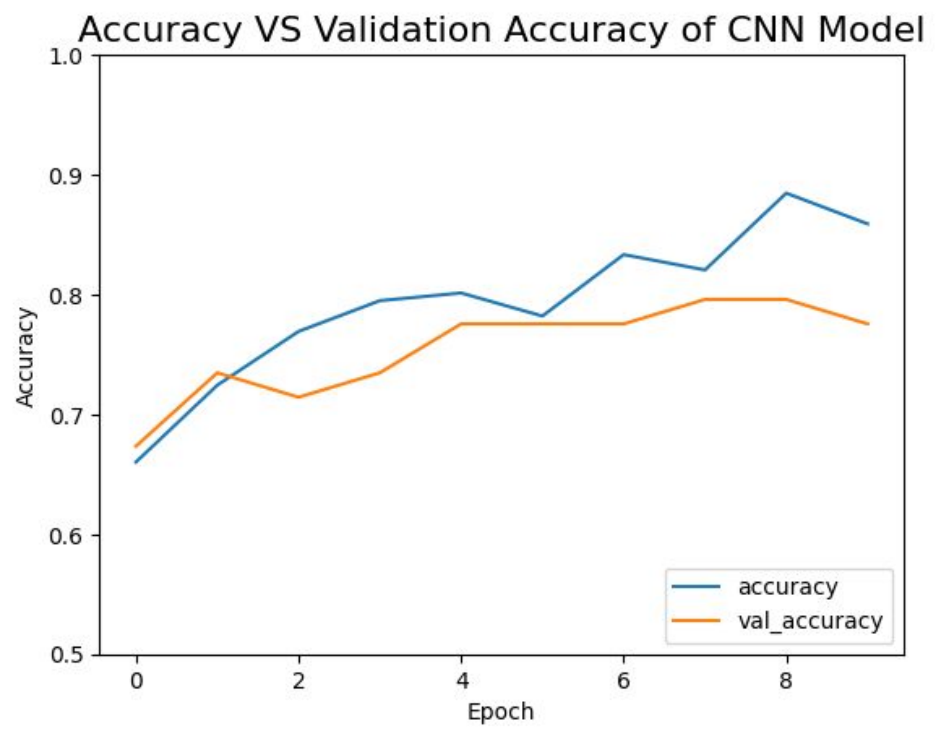
CNN Architecture

Preprocessing	Convolutional Layers	Training
• Resize images to 64x64 • Normalise pixel values to 0 – 1	• 3 convolutional layers with ReLU activation • 2 max-pooling layers • Flatten + fully connected dense layers	• 10 epochs • Adam optimiser • Sparse categorical crossentropy loss • Tracked metric: Accuracy • Train/Validation/Test split

Training Performance

- **Final Training Accuracy:**
  - 83.3%
- **Validation Accuracy:**
  - Peaked at 79.6%
  - Ended at 77.6%
- **Final Test Accuracy:**
  - 77.6%

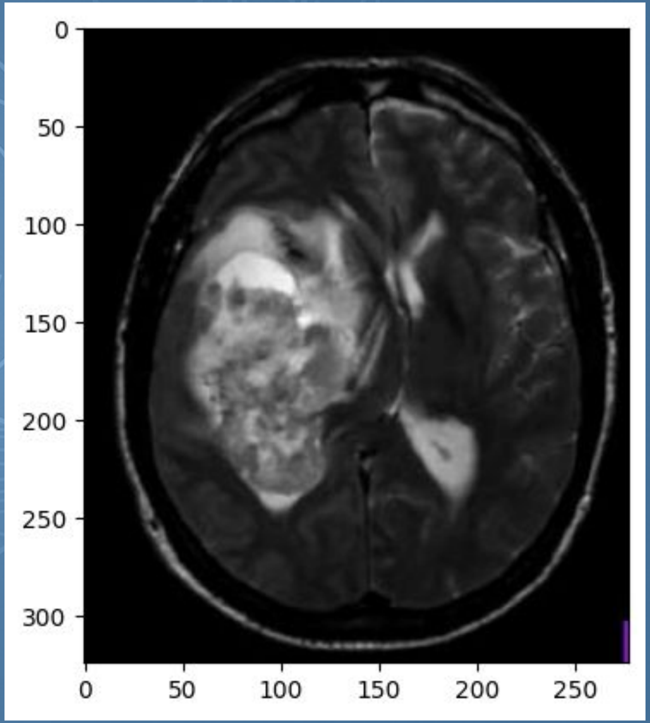
- Model generalises well, with slight drop hinting at mild overfitting



Testing on an Unseen Image

- A new unseen MRI scan was tested
- **Output:** Predicted Class: 1 (Tumour detected)

- Confirms ability to detect abnormalities beyond training data



Benefits of AI-Assisted Diagnosis

- Increases diagnostic accuracy and speed
- Reduces healthcare workload
- Helps detect subtle anomalies early
- Allows faster, data-driven decisions and personalised care

Challenges in AI Adoption

- Requires large, high-quality datasets
- Training is resource-intensive
- Medical expert oversight is crucial
- Ethical concerns:
    - Bias in datasets
    - Data privacy
    - Accountability in medical decisions

Conclusion & Future Directions

Key Takeaways:

- CNN model achieved 77.6% test accuracy for tumour detection
- Solid learning curve with no major signs of overfitting
- AI offers major diagnostic potential but requires ethical oversight, high-quality data, and clinical validation

Future Improvements:

- Train on larger, more diverse datasets to improve generalisability
- Expand to multi-class classification (e.g. distinguishing tumour types)
- Consider real-time or 3D MRI integration for clinical relevance

References

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