**Technical Report: Alzheimer's Disease Neuroimaging Dashboard Analysis**

**1. Outline**

* Introduction
* Story of Data
* Data Splitting and Preprocessing
* Pre-Analysis
* In-Analysis
* Post-Analysis and Insights
* Data Visualizations & Charts
* Recommendations and Observations
* Conclusion
* References & Appendices

**2. Introduction**

**Objective of the Project:**  
To visually analyse brain scan image metrics to understand structural and brightness variations in Alzheimer's patients across different disease stages. The dashboard aims to assist in identifying neuroimaging biomarkers associated with disease progression.

**Problem Being Addressed:**  
Early detection of Alzheimer's is often hindered by the subtle progression of neurodegeneration in brain scans. This project provides a visual and statistical summary of scan-based indicators to support early diagnosis and disease stage classification.

**Key Datasets and Methodologies:**  
MRI scan data and associated neuroimaging metrics (clarity, brightness, entropy) were processed and visualized in Power BI. Metrics include disease stage labels, pixel intensity analysis, entropy distributions, and clarity index.

**3. Story of Data**

**Data Source:**  
The dataset was sourced from publicly available Alzheimer’s Disease neuroimaging repositories (e.g., OASIS, ADNI).

**Data Collection Process:**  
Scans were collected for individuals across different cognitive stages (Non-Demented, Mild Demented, Moderate Demented, V-Mild Demented), with extracted metrics for radiance, entropy, and intensity values.

**Data Structure:**

* Rows represent individual scan entries
* Columns include diagnosis, pixel statistics, entropy level, and brightness progression

**Important Features and Their Significance:**

* **Disease Progression (Score):** Quantifies neurological deterioration
* **Radiance & Brightness:** Measure grey/white matter contrast
* **Entropy:** Quantifies randomness in scan texture
* **Clarity:** Assesses structural definition

**Data Limitations or Biases:**  
Some patient categories have fewer samples (e.g., Moderate Demented), possibly impacting result generalizability. Scan quality and equipment variability are not standardized.

**4. Data Splitting and Preprocessing**

**Data Cleaning:**  
Pre-processed metrics were already aggregated. Labels were normalized, and blank entries were filtered using Power BI’s built-in filtering tools.

**Handling Missing Values:**  
Missing values were negligible. Data integrity was maintained through visual cross-checks.

**Data Transformations:**  
To enable more insightful analysis, several new columns and DAX measures were introduced:

* **Severity Score:** Translates categorical diagnosis into ordinal numerical values (non-demented = 0 to Moderate Demented = 3).
* **Disease Progression:** Average of Severity Scores across the dataset.
* **Scan Disorder Level:** Average entropy for all non-healthy scans (Severity > 0).
* **Radiance Progression:** Average mean pixel intensity across all scans.
* **Brightness Variation:** Average of standard pixel intensity values.
* **Central Brightness Trend:** Focused on average centre brightness, highlighting localized scan variations.
* **Composite Severity:** A weighted composite score calculated from normalized (z-scored) entropy, edge density, and centre brightness:
  + 40% weight to texture complexity (entropy)
  + 30% to structural detail (edge density)
  + 30% to central brightness

These transformations help quantify complex imaging traits for comparative and predictive purposes.

**Data Splitting:**

* **Dependent Variables:** Disease stage, entropy level, brightness progression
* **Independent Variables:** Pixel intensity, clarity score, radiance values

**Industry Context:**  
Neurological health and AI-driven medical diagnostics.

**Stakeholders:**  
Medical researchers, radiologists, neurologists, and healthcare AI developers.

**Value to the Industry:**  
Improves understanding of early-stage Alzheimer’s detection through imaging biomarkers and supports AI model training.

**5. Pre-Analysis**

**Key Trends:**

* Disease progression value: 1.50
* Entropy variation slightly higher in diseased scans
* Brightness variation: 78.91 average, higher in more advanced stages

**Potential Correlations:**

* Higher disorder level aligns with greater radiance progression
* Lower structural clarity is strongly linked with cognitive deterioration

**Initial Insights:**  
Moderate dementia scans consistently exhibit the lowest clarity and highest pixel disorder.

**6. In-Analysis**

**Unconfirmed Insights:**

* Very mild cases show near-identical entropy to healthy controls, indicating potential challenges in early-stage diagnosis
* Some scans with low brightness variation still demonstrate high progression scores

**Recommendations:**

* Combine entropy and brightness metrics for a composite indicator of early-stage detection
* Reinforce training datasets with more Moderate Demented scans for model balance

**Analysis Techniques Used in Power BI:**

* Donut charts for entropy distribution
* Bar charts for clarity and pixel intensity by condition
* KPI tiles for neuroimaging stats (e.g., brightness, radiance)
* Image slider for comparing scan visuals

**7. Post-Analysis and Insights**

**Key Findings:**

* Non-Demented scans had highest clarity (1067 score), while Moderate Demented had the lowest (739)
* Standard pixel intensity varies across stages, lowest in Moderate Demented
* Central brightness metric peaks at 147.93 in advanced stages

**Comparison with Initial Findings:**  
Confirmed expectations of clarity loss and radiance shifts. However, early-stage cases (V-Mild Demented) still maintained relatively normal entropy, suggesting caution in relying solely on that metric.

**8. Data Visualizations & Charts**

* **KPI Cards:** Radiance, brightness, entropy, and progression indicators
* **Bar Charts:** Clarity and pixel intensity comparison
* **Donut Chart:** Entropy level distribution by diagnosis group
* **Image Gallery:** Top healthy vs. diseased scans for visual pattern comparison

A screenshot of a medical information

AI-generated content may be incorrect.

Each visual assists clinicians in contextualizing raw neuroimaging numbers against real scan visuals.

**9. Recommendations and Observations**

**Actionable Insights:**

* Develop models using brightness and radiance as primary indicators
* Prioritize image-based diagnosis tools for non-specialist accessibility
* Target Moderate Demented patients for clinical re-validation due to distinct scan patterns

**Optimizations or Business Decisions:**

* Incorporate image metrics into early-screening apps for general clinics
* Offer structured scan-based reports for radiology labs

**Unexpected Outcomes:**

* V-Mild Demented patients display entropy levels almost identical to non-demented, complicating early detection

**10. Conclusion**

**Key Learnings:**  
Scan clarity, pixel brightness, and radiance progression are reliable indicators of Alzheimer’s severity. Entropy alone may be misleading without contextual interpretation.

**Limitations:**  
Data may be biased toward certain scanner types or regions. Diagnostic labels are not clinically validated within the dashboard scope.

**Future Research:**

* Integrate longitudinal patient scans
* Compare manual vs. AI-based diagnosis using same dataset
* Include demographic overlays for deeper insights

**11. References & Appendices**

**References:**

* OASIS Brains dataset, ADNI Initiative
* Power BI metrics dashboard logic

**Appendices:**

* Neuroimage metrics data
* Scan sample visuals (included)
* Power BI model schema and calculations