

# Multi-Modal AI System for Early Cancer Detection

## Abstract

This document presents a novel artificial intelligence system designed to detect early-stage cancers by jointly analyzing multi-modal medical imaging data, including CT, MRI, and PET scans. The system leverages deep learning with a proprietary feature fusion architecture to correlate subtle cross-modal patterns that may be overlooked in single-modality analysis.

## System Overview

The proposed system ingests synchronized CT, MRI, and PET imaging data and processes them through modality-specific encoders. A cross-modal attention layer aligns semantic features across modalities, allowing the model to learn interdependencies between anatomical structure, metabolic activity, and tissue contrast.

## Key Innovations

- Cross-modal attention mechanism enabling dynamic feature alignment across CT, MRI, and PET modalities.
- Uncertainty quantification layer that outputs confidence estimates for each diagnostic prediction.
- Explainable AI visualization module that highlights contributing regions in each imaging modality for clinical interpretation.

## Clinical Impact

By integrating complementary imaging modalities and providing interpretable outputs with confidence measures, the system aims to support radiologists in identifying early-stage malignancies with improved sensitivity and reduced false positives. This approach positions the system as a decision-support tool rather than a standalone diagnostic authority.

## Disclaimer

This document is provided for research and testing purposes only. The described system does not constitute medical advice or a clinically validated diagnostic tool.