SMART INDIA HACKATHON 2025

Quantum Care

TITLE PAGE

- **Problem Statement ID – 25132**
- **Problem Statement Title-Student Innovation**
- **Theme-MedTech / BioTech / HealthTech**
- **PS Category- Software**
- **Team ID - 77014**
- **Team Name-Quantum Care**

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AI-Powered Early Disease Detection

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OPPORTUNITY (Why?)

Early detection is paramount to **cancer survival**, yet the current healthcare model often struggles with **delayed diagnosis**, resulting in **poor treatment outcomes** and **low survival rates**. The reliance on slow, error-prone, and inefficient **manual diagnosis** (human review of X-rays, CTs, and MRIs) is not equipped for high-volume screening and frequently lacks the sensitivity to catch **pre-symptomatic malignancy**.

The immense opportunity lies in leveraging **Artificial Intelligence**, specifically **Deep Learning**, to fundamentally shift the timeline from reactive treatment to **proactive prevention**. A unified AI-driven system can enable **Early Stage Detection** for major cancers (such as **Lung, Brain, Skin, and Blood**), ensuring patients receive **Better Treatment** sooner. This transformation promises to **drastically improve survival rates** for millions worldwide while simultaneously **reducing healthcare costs**.

Idea (What?)

Our platform is an intelligent, deep-learning based system that analyzes multi-modal medical data (imaging, pathology slides, genomic reports) to rapidly and accurately identify malignant tissue, predict cancer risk, and assist clinicians in diagnosis and prognosis

Proposed Solutions(How?)

- ✓ **Multi-Modal Image Processing:** Collects diverse images (X-ray, CT, MRI, Dermoscopy) and applies Noise Removal and a Segmentation Model to isolate the areas of interest for efficient analysis.
- ✓ **Deep Learning Classification (CNN):** The image segment is analyzed by a Convolutional Neural Network (CNN), which performs high-sensitivity Feature Extraction to determine the probability of malignancy and generates the Final Prediction.
- ✓ **Real-Time, Explainable Output (XAI):,** Explainable Output (XAI): Accelerated by GPU, the system delivers Real-Time Analysis and a Visual Diagnostic Report featuring heatmaps and a confidence score to aid the clinician.
- ✓ **High-Risk Data Flagging:** Upon a Malignant/High-Risk classification, the diagnostic data is instantly and securely logged, triggering an alert for the subsequent AI Chatbot Patient Navigator.
- ✓ **Suggest Specialists:** Recommend the most appropriate onco-specialist .
- ✓ **Facilitate Booking**: Guide the patient through the next steps for early treatment, potentially even initiating the appointment scheduling process based on the risk level.
- ✓ **Patient Education and Support:** The Chatbot provides immediate, accurate information about the next steps, answering common patient FAQs and reducing the anxiety associated with waiting for a critical appointment.

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TECHNICAL APPROACH

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Tech-Stack

Frontend:ReactJS / Angular (for Clinical Dashboard)Material-UI (for modern design)

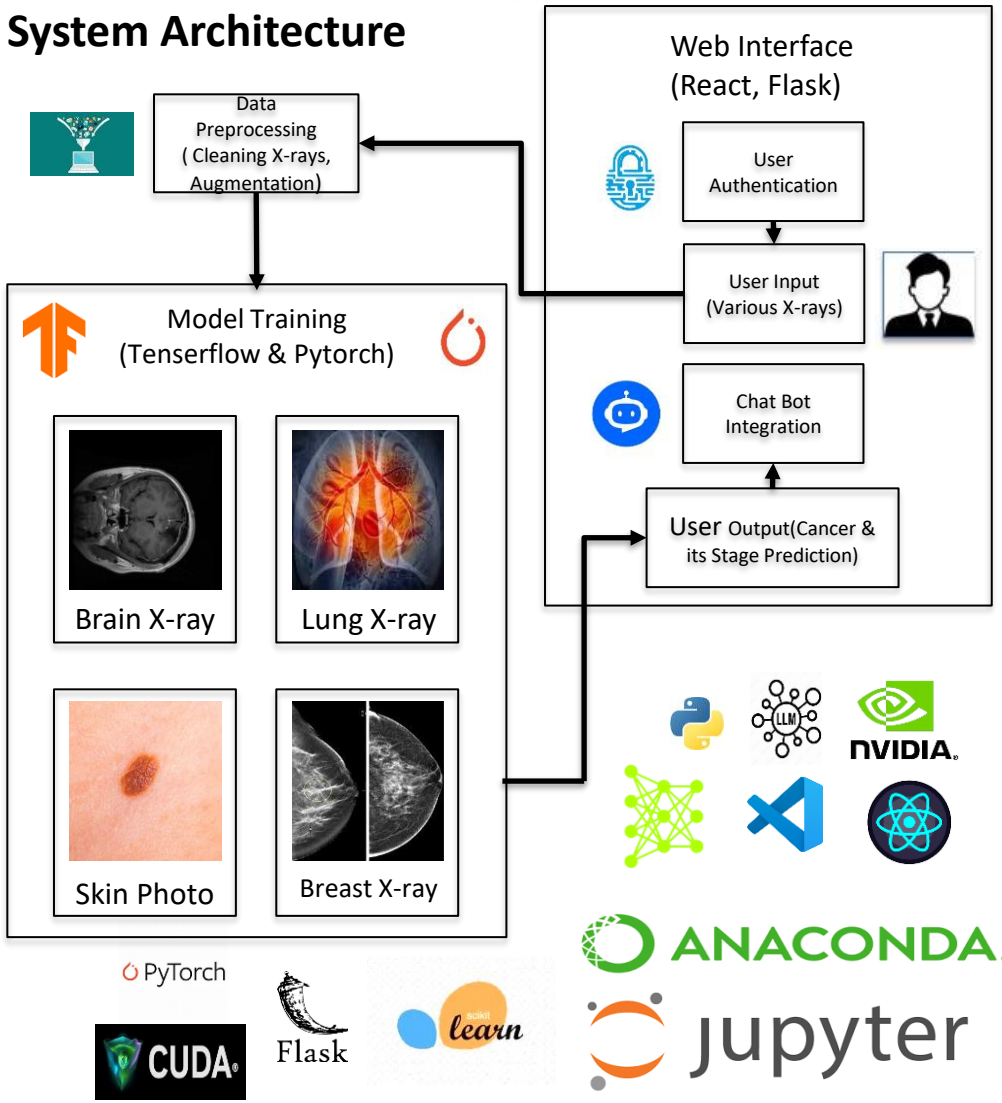
Backend / API Layer:Python (Flask / FastAPI - for high-performance API)PostgreSQL (for secure data storage)

AI and ML (Core Engine):PyTorch and TensorFlow (Deep Learning Frameworks)NVIDIA CUDA (GPU acceleration)CNN Architectures (for classification)OpenCV, Scikit-image (for image processing, segmentation)Grad-CAM (for XAI heatmap generation)

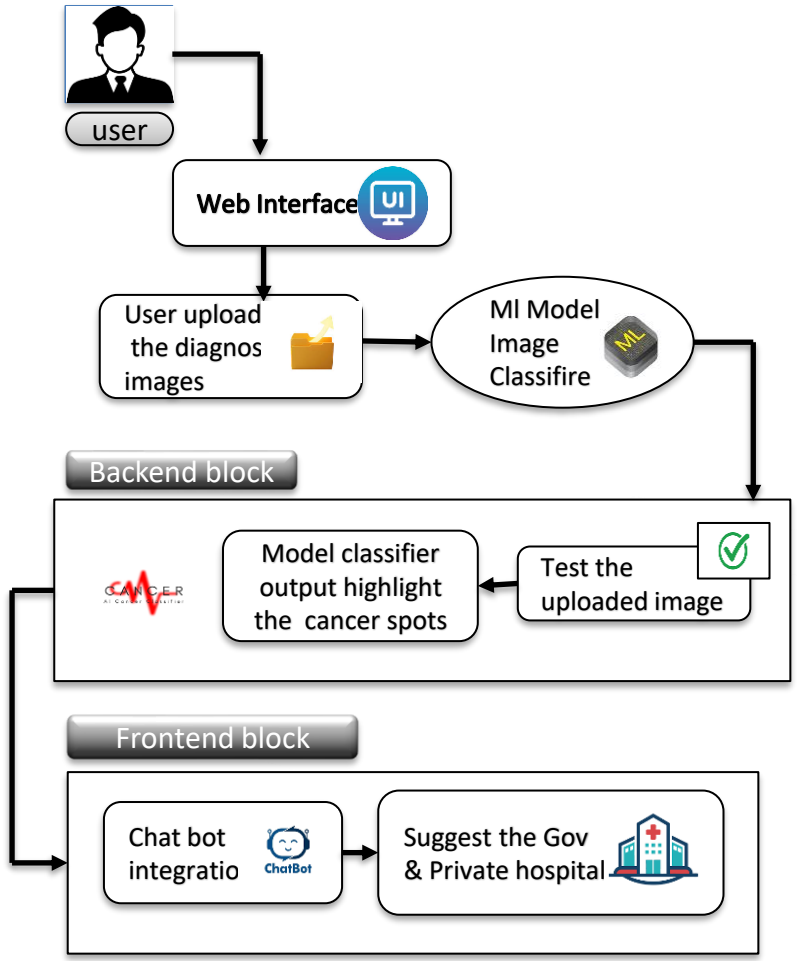
Dataset50,000+ Multi-Modal Medical Images (for training and validation) Explainability (XAI)Grad-CAM, Heatmaps & Confidence Scores

Chatbot : GrowthCustom NLP, Continuous Learning

System Architecture



Process Flow



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FEASIBILITY AND VIABILITY

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Feasibility

- ✓ Availability of large medical imaging datasets for model training.
- ✓ Proven success of AI in medical image classification and diagnostics.
- ✓ Integration with existing hospital IT systems and diagnostic tools.
- ✓ Affordable cloud-based infrastructure for scalable deployment.

Viability

- ✓ Reduces diagnostic time and cost for hospitals and patients.
- ✓ Enhances early detection rates, improving survival chances.
- ✓ Supported by government & healthcare initiatives promoting AI in healthcare.
- ✓ Potential for partnerships with hospitals, labs, and diagnostic centers.

Challenges

- ✓ Data privacy and compliance with HIPAA/GDPR regulations.
- ✓ Limited access to balanced, high-quality medical datasets.
- ✓ Risk of false positives/negatives impacting patient trust.
- ✓ Resistance from medical professionals toward AI-driven diagnostics.

Solutions

- ✓ Implement strong data encryption and secure data handling protocols.
- ✓ Use federated learning to train AI models without sharing raw patient data.
- ✓ Continuous model validation and feedback from medical experts.
- ✓ Conduct awareness programs for doctors on AI's role as a supportive tool.

Use Cases

- ✓ Automated detection of breast, lung, and skin cancers in imaging scans.
- ✓ AI-powered triage to prioritize high-risk patients in hospitals.
- ✓ Remote cancer screening for rural/underserved communities.
- ✓ Real-time decision support system for oncologists.

Business Potential

- ✓ Growing $200B+ global AI healthcare market opportunity.
- ✓ Licensing AI software to hospitals and diagnostic centers.
- ✓ SaaS model for clinics, labs, and telemedicine platforms.
- ✓ Expansion into multi-disease early detection beyond cancer.

★Supporting Facts for Feasibility and Viability★

→ Applying Deep Learning to Medical Imaging: A Review

→ MedicalPatchNet: A Patch-Based Self-Explainable AI Architecture for Chest X-ray Classification

→ Explainable AI in medical imaging: an interpretable and collaborative federated learning model for brain tumor classification

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IMPACT AND BENEFITS

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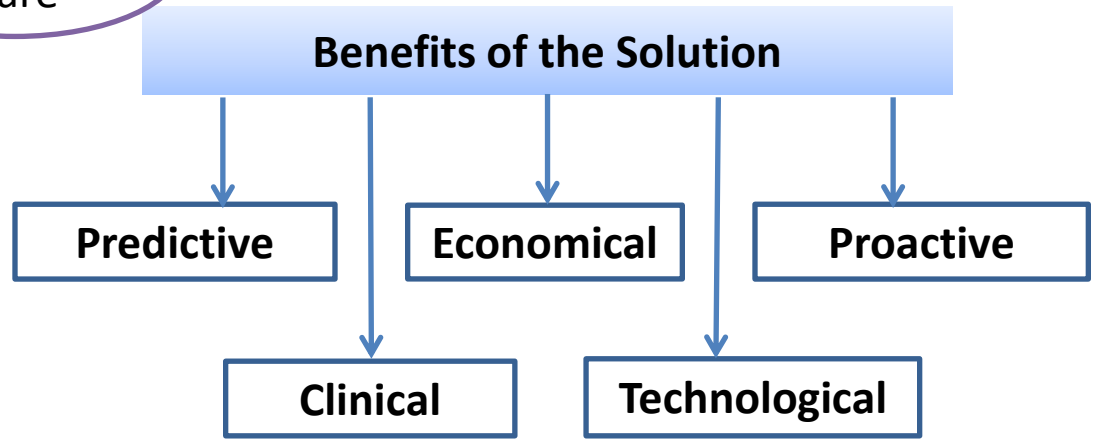

❖ Impact on Target Audience

Impact on Patients & the General Public

- ✓ Dramatically improves survival rates and quality of life by enabling early, less invasive treatments.
- ✓ Empowers individuals with personalized risk assessments, allowing for proactive health management.

Impact on Healthcare Professionals

- ✓ Augments clinical expertise by detecting subtle disease markers, significantly increasing diagnostic accuracy.
- ✓ Increases workflow efficiency by automating analysis and prioritizing urgent cases for review.

Impact on Healthcare Systems

- ✓ Drastically reduces long-term operational costs by shifting treatment to earlier, less expensive stages.
- ✓ Facilitates targeted public health strategies and better resource allocation by identifying at-risk populations.

❖ Benefits of Solution

Predictive

- ✓ Identifies high-risk individuals and forecasts disease onset by analyzing complex health data.
- ✓ Provides early warnings by uncovering predictive patterns that are otherwise undetectable.

Clinical

- ✓ Enhances diagnostic accuracy and speed by serving as a powerful decision-support tool for clinicians.
- ✓ Leads to more effective treatments and significantly improved patient health outcomes.

Economical

- ✓ Lowers overall healthcare costs for both patients and the system by enabling cheaper, early-stage treatment.
- ✓ Minimizes the wider economic impact by reducing productivity loss from advanced diseases.

Technological

- ✓ Represents a major advancement in medical technology by enabling the rapid analysis of complex datasets.
- ✓ Creates a foundation for future AI-driven healthcare research and diagnostic innovations.

Proactive

- ✓ Shifts the focus of healthcare from reactive treatment to proactive prevention through timely intervention.
- ✓ Empowers patients and doctors with early warnings, allowing them to take preventive health measures.

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RESEARCH AND REFERENCES

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Refrences

- Existing Platforms
  - Quibim-https://www.quibim.com/
  - Clarity_Breast - https://www.bcrf.org/blog/clairity-breast-ai-artificial-intelligence-mammogram-approved/?utm_source=chatgpt.com
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Feature / Parameter	Existing Apps (General)	Early Stage Cancer Detection App (Proposed)
Detection Focus	Detects only advanced or visible cancer signs	Detects **early-stage & tiny nodules** with high sensitivity
Imaging Modalities	Limited (mostly X-ray or CT only)	Supports **multi-modality** (X-ray, MRI, CT, Dermoscopy)
Accuracy & Sensitivity	Moderate accuracy, higher false negatives	**High sensitivity & accuracy**, reduces missed cases
Explainability	Minimal or no visual explanations	Provides **heatmaps & highlighted suspicious regions**
Doctor Support	Standalone, limited assistance	Acts as a **decision-support tool** for radiologists
Deployment	Complex integration, device-specific	**Web & PACS-integrated**, user-friendly hospital adoption
Data Privacy & Compliance	Basic data handling	Strict **HIPAA/GDPR compliance** with encryption
Adaptability & Learning	Static models, little improvement over time	**Continuous learning** from new hospital data & feedback
Business Reach	Limited to specific hospitals or regions	Scalable, **cloud-ready**, adaptable for global use