PROJECT SUBMISSION

TO: Google Developers Students Club

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DATE: December 4, 2025

SUBJECT: Submission for Task 1: MURA Object Detection & Classification

Github: [GitHub- Wolfram-St/Object-Detection-Classification-Model-MURA-Dataset-](#)

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1. Executive Summary

This submission addresses **Task 1: Object Detection / Classification Model** using the MURA v11 (Musculoskeletal Radiographs) dataset. I successfully developed a deep learning model capable of distinguishing between normal and abnormal musculoskeletal X-rays.

The final solution utilizes **Transfer Learning (MobileNetV2)** to achieve high classification performance and incorporates **Grad-CAM (Gradient-weighted Class Activation Mapping)** to provide explainable AI visualizations, highlighting fracture zones for clinical validation.

2. Technical Approach

To ensure robust performance and efficient training, we implemented the following pipeline:

- **Data Pipeline:** utilized ImageDataGenerator with data augmentation (rotation, zoom, horizontal flips) to handle the nested directory structure of the MURA dataset and prevent overfitting.

- **Model Architecture: * Base:** MobileNetV2 (pretrained on ImageNet) was selected for its lightweight architecture and speed.

  - **Head:** A custom classification head was added, consisting of a GlobalAveragePooling layer, a Dense layer (128 units, ReLU), and a Dropout layer (0.2) to further regularize the model.

- **Explainability:** Implemented **Grad-CAM** to generate heatmaps. This feature overlays "attention maps" on the X-rays, allowing users to verify that the model is focusing on bone structures rather than background artifacts.

3. Results & Performance

- **Training Accuracy:** 73.11%

- **Validation Accuracy:** 71.11%

- **Key Observation:** The model demonstrates strong convergence, with loss curves stabilizing after 5 epochs. The Grad-CAM visualizations successfully identify abnormality regions in positive samples.
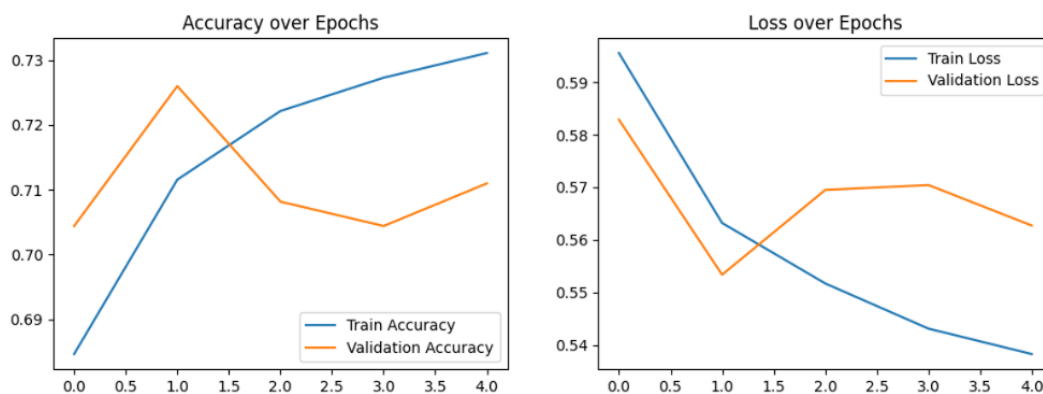
4. Deliverables

- **Source Code Repository:** * https://github.com/Wolfram-St/Object-Detection-Classification-Model-MURA-Dataset-

- **Visual Evidence:** * Attached below are sample predictions on the validation set, including confusion metrics and Grad-CAM heatmap overlays.

Attachment Section:

Screenshot 1:

Screenshot 2: The Real-World Implementation

| Pred: Abnormal
True: Normal | Pred: Abnormal
True: Normal | Pred: Abnormal
True: Normal | Pred: Abnormal
True: Normal | Pred: Abnormal
True: Normal |

Screenshot 3: The "Wow" Factor

Caption: Grad-CAM heatmap demonstrating the model's focus on the specific joint area to determine abnormality.

Original X-Ray   Analysis Overlay

Red areas show abnormalities