CSE7101- Capstone Project

Review-1

Develop a functional solution that demonstrates the face liveness detection

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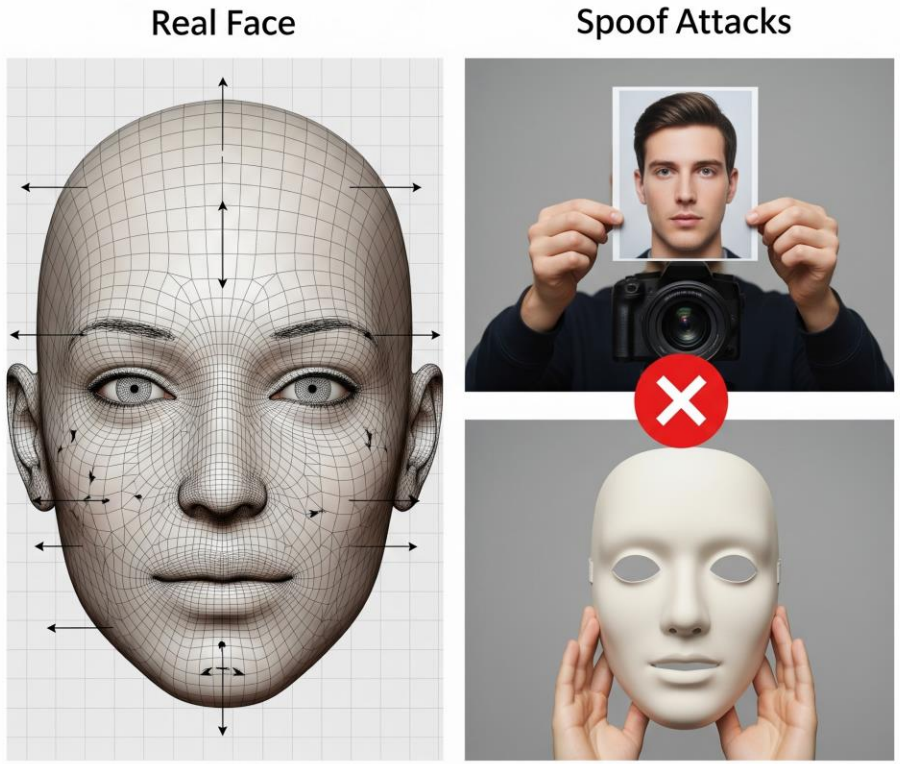
Problem Statement Number: PSCS_207

Organization: MeiTY, GoI.

Category: Software

Problem Description:

This project is centered on creating passive or active liveness detection model to prevent face spoofing from photos or videos, a core computer vision security task.



Analysis of Problem Statement

In today's rapidly advancing era of AI, distinguishing real faces from fake ones has become increasingly challenging, especially for authentication. This has led to the rise of Face Liveness Detection as a critical solution. The current solutions do exist but poses several challenges:

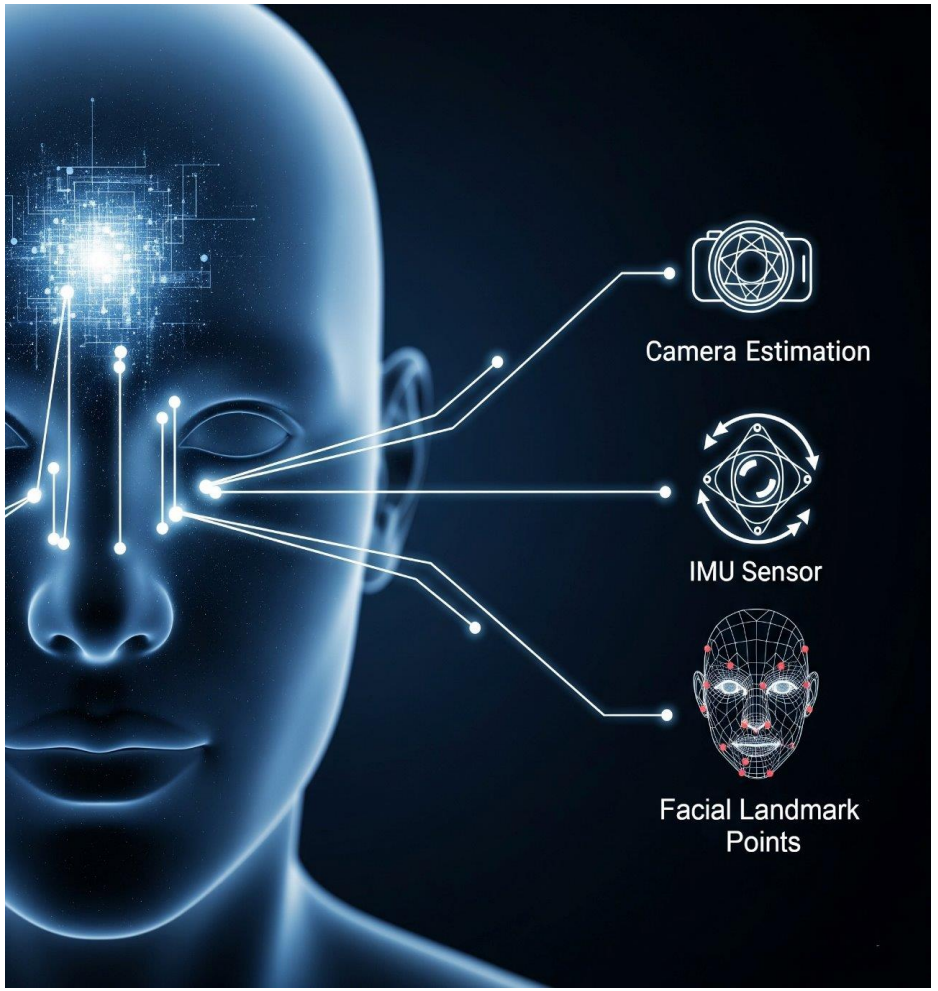
- Susceptibility to spoofing (replay/photos/masks/deepfakes)
- Dependence on cloud → privacy & latency issues
- On-device tiny models exist, but trade size for robustness
- Poor generalization across lighting, devices, demographics.

Solution: We propose a light weight face detection model which indeed supports larger devices but it specifically empowers smaller devices for the purpose of authentication.

Our Solution

Inputs (Modalities):

- **Camera (Texture + Depth cues):** Detects fine facial textures and 3D depth through shading, shadows, and reflections.
- **IMU (Accelerometer + Gyroscope):** Validates natural head/device motion consistency (a flat replay doesn't move naturally).
- **Ambient Sensors (Minimal):** Light sensor to spot flicker from screens, proximity sensor to detect flat objects close to camera.
- **Audio (Future Work):** Micro-challenges (e.g., "say 47"), for advanced spoof cases.



Our Solution

Backbone:

- Tiny neural nets **(MobileNetV3, ShuffleNet, MobileFaceNet)** 1–2 MB compressed via quantization, pruning, distillation.
- **Attention(CBAM/Coordinate Attention):** to Focusses on eye/skin texture.
- **Real-time:** 10–30 ms/frame even on low-end phones.
- **Fusion:** Early fusion of Camera + IMU features ensures robust liveness detection.
- **Output:** Scalar live/spoof score; decision threshold applied.

Tech Stack

1. **Programming Language:** Python – Model development & prototyping
2. **Deep Learning Frameworks**
- PyTorch / TensorFlow – Model training & prototyping
- TensorFlow Lite / ONNX Runtime – Lightweight mobile deployment
3. **Computer Vision Libraries**
- OpenCV – Face detection, preprocessing, depth cues
- Dlib / Mediapipe – Facial landmarks & pose estimatio
4. **Data Handling & Processing**
- NumPy, Pandas – Data manipulation
- Matplotlib / Seaborn – Visualization & debugging
5. **Version Control & Collaboration:** Git & GitHub – Repository management & teamwork
6. **Model Optimization Tools**
- TensorFlow Model Optimization Toolkit – Pruning, quantization
- ONNX Runtime / TFLite Converter – Model size reduction & mobile deployment

Application & Challenges

Applications:

- On-device banking/authentication
- Privacy-preserving ID verification
- Secure liveness for low-end devices

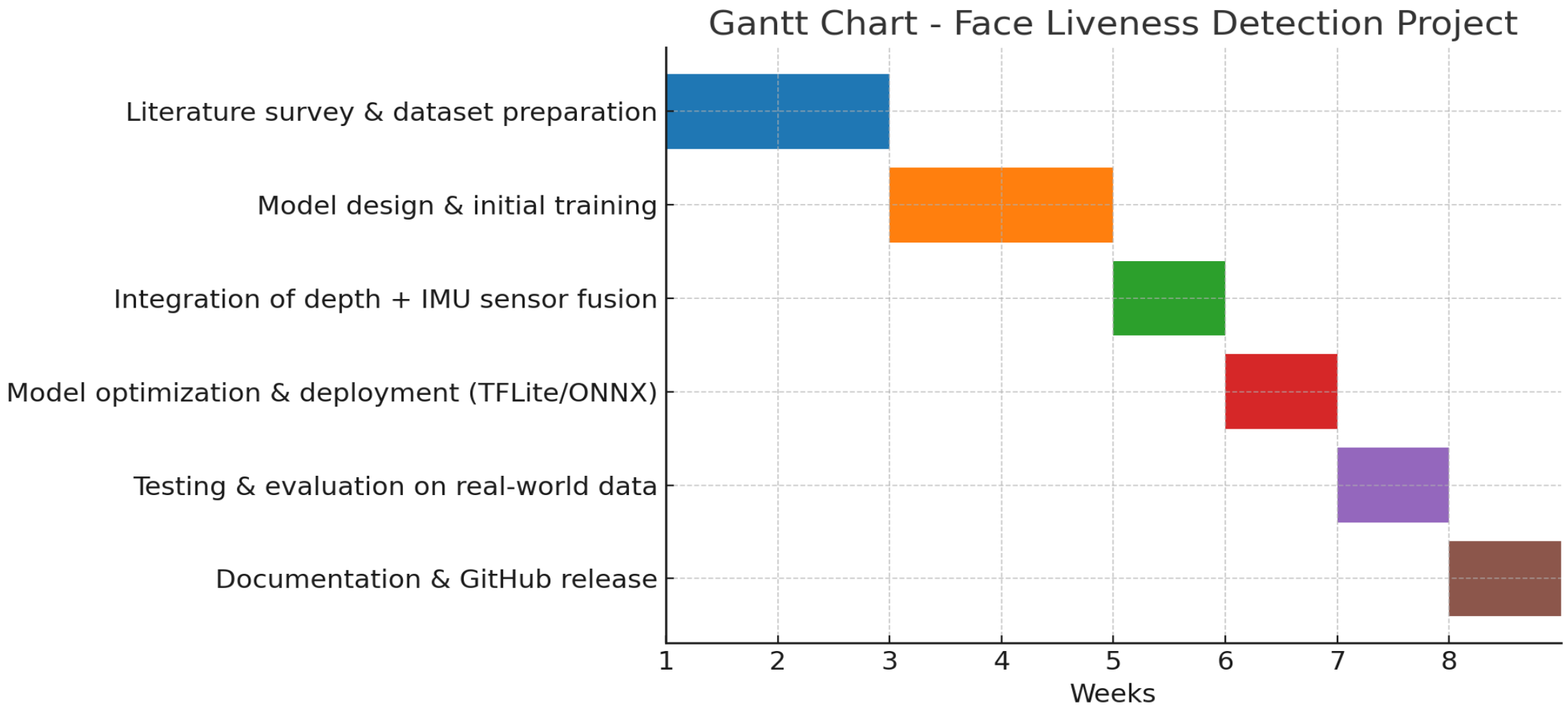
Challenges:

- **L**ow-light or fast motion reduces depth-texture reliability
- Device camera/IMU variability
- Fairness across demographics.
- Maintaining robustness vs new spoofing methods

Github Link

https://github.com/DeepakDevangShetty/FaceLiveliness_Detection.git

Timeline of the Project (Gantt Chart)



References (IEEE Paper format)

[1]. R. Steiner, et al., "A Multi-Modal Approach for Face Anti-Spoofing in Non-Calibrated Systems using Disparity Maps," *arXiv preprint arXiv:2410.24031*, Oct. 2024.

[2]. M. A. Al-Azawei and A. J. Jarallah, "Face Anti-Spoofing Detection with Multi-Modal CNN Enhanced by ResNet," *ResearchGate*, Preprint, Aug. 2025.

[3]. J. Li, et al., "A MobileFaceNet-Based Face Anti-Spoofing Algorithm for Low-Quality Images," *Electronics*, vol. 13, no. 14, p. 2801, Jul. 2024.

[4]. Y. Wang, et al., "Face Anti-Spoofing Based on Deep Learning: A Comprehensive Survey," *Applied Sciences*, vol. 15, no. 12, p. 6891, Jun. 2025.

[5]. Y. Wang, et al., "Face antispoofing method based on single-modal and lightweight network," *Journal of Electronic Imaging*, vol. 33, no. 3, Jun. 2024.

[6]. S. S. Gaikwad and P. D. S. Ugale, "Face Anti-Spoofing Methods: A Comparative Analysis through the Lens of a Comprehensive Review," *International Journal for Research in Applied Science & Engineering Technology*, vol. 12, no. 2, pp. 1133-1141, Feb. 2024.


Thank
You!