EEE 451: AI Deep Dive

Smart Attendance System Technical Report
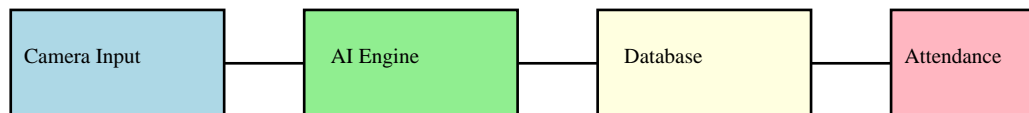
Prepared for: EEE 451 Project Submission

Topic: Artificial Intelligence Models (YuNet, SFace, and Liveness Logic)

February 2026

Chapter 1: The Big Picture

This project uses Artificial Intelligence (AI) to solve the problem of automated attendance. It uses a sequence of specialized AI models to identify a student and ensure they are physically present.

Figure 1: High-Level System Architecture

| Camera Input | | AI Engine | | Database | | Attendance |

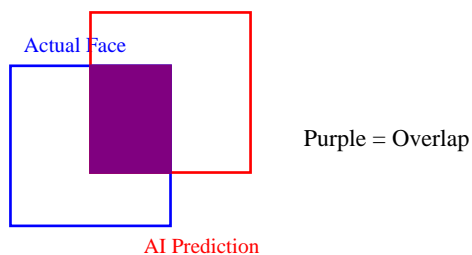# Chapter 2: Face Detection (YuNet)

Before recognizing a face, we must find it. **YuNet** is a fast, anchor-free detector that locates faces and key landmarks (eyes, nose, mouth).

Math: Intersection over Union (IoU)

IoU measures how accurate the detection box is compared to the real face position.

```
Formula: IoU = (Area of Overlap) / (Area of Union)
```

Figure 2: Understanding IoU

Actual Face

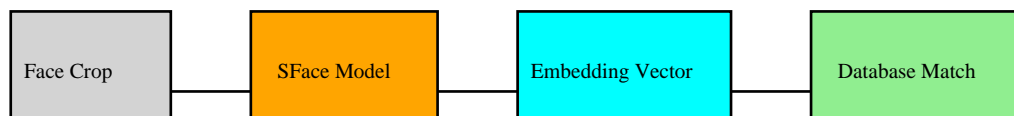Purple = Overlap

AI Prediction

Chapter 3: Face Recognition (SFace)

SFace converts a face into a 128-dimensional vector (embedding). We compare these vectors using Cosine Similarity.

```
Formula: Similarity = cos(θ) = (A · B) / (||A|| * ||B||)
```

In this project, a threshold of 0.363 is used for verification.

Figure 3: Recognition Pipeline

Face Crop	SFace Model	Embedding Vector	Database Match

Chapter 4: Liveness Detection

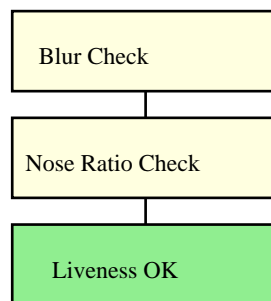To prevent spoofing (using a photo), we use Laplacian Blur scores and the Nose Ratio challenge.

Nose Ratio Formula:

```
Ratio = (Nose_X - Bbox_Left) / Bbox_Width
```

Real 3D faces show a dynamic shift in this ratio when turning, while 2D photos remain static.

Figure 4: Anti-Spoofing logic

Chapter 5: Conclusion

By integrating YuNet, SFace, and robust liveness heuristics, this system provides a secure and efficient way to manage student attendance using modern AI.

End of Report