



Face Hunt System On Photo/Video Processing

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Abstract : Face recognition technology is of great economic value and in great demand with the growth of big data. This paper discusses the design of a real-time video processing-based facial recognition system based on the Arc Face algorithm, which is a cutting-edge method for face recognition. The research compares the accuracy, stability, truancy rate detection, and user interface settings of the system. It performs comparative performance testing before and post the deployment of Arc Face in terms of key measures like accuracy rate, false acceptance rate (FAR), false rejection rate (FRR), and processing speed. The research also explores real-world applications and problems and the necessity of face recognition in security, attendance tracking, and surveillance. The findings reveal that Arc Face significantly improves system accuracy and reliability, and that is a sound solution for real-time identity verification.

IndexTerms - Facial Recognition, Real-time Video Processing, Arc Face, Biometric Security, Identity Verification, Attendance System, Crime Prevention, Feature Embedding, Angular Margin Loss, Face Detection, Feature Extraction, Face Matching, False Acceptance Rate (FAR), False Rejection Rate (FRR).

I. Introduction

Keeping identity verification and monitoring accurate in many applications, including crime prevention and education, is important. The classic approaches generally involve roll calls or monitoring people, which can be wasteful and prone to errors. Facial recognition technology offers a new biometric security method that identifies individuals based on facial features. Whereas the technology has been used widely in law enforcement, recent innovation has opened its use to education and crime prevention. This study aims to design and test a facial recognition system based on real-time video processing to improve accuracy and efficiency.

II. Related Work

Some studies have explored the use of facial recognition in crime watch and student tracking systems.

Khan [1] et al. (2020) offered a Class Checker Management System Using Facial Recognition, which automatically monitors students with reduced human intervention. Bhattacharya [2] et al. (2020) utilized a Student Checker System Using Face Link Technique, which enhanced the accuracy of student tracking. Al-Alsawi [3] et al. (2018) explored a Class Checker System Based on Face Link to counteract fraud and enhance security systems.

Singh [4] et al. (2019) performed a survey of Checker Management Systems Based on Computer Vision Techniques, comparing different face recognition methods. Awan [5] et al. (2017) provided an in-depth review of Facial Recognition Technology, emphasizing its potential uses and limitations. This work is based on previous work by introducing Arc Face, a high-end face recognition engine, to enhance identification accuracy and resistance in real-time video processing systems.

III. What is Facial Recognition?

Facial recognition technology identifies or verifies a person by analysing facial features in images or real-time video feeds. It is widely used in biometric security, including fingerprint and iris recognition systems.

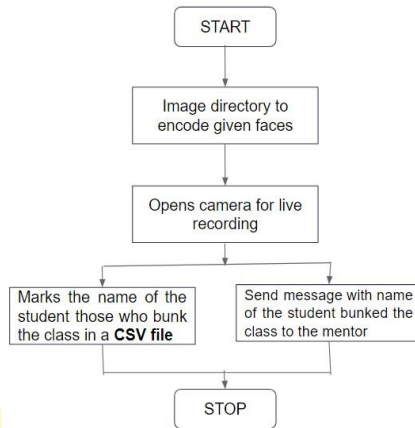


Figure 1: Flow Diagram of the process

The process involves multiple stages:

1. Face Detection – Identifies faces in images or video streams.
2. Feature Extraction – Analysis facial features such as eye distance, nose shape, and chin structure.
3. Face Encoding – Converts facial features into digital data.
4. Face Matching – Compares extracted features against a database.

IV. Algorithm Used: Arc Face

Arc Face is a cutting-edge facial recognition algorithm designed to improve accuracy and robustness. It enhances the discrimination capability of facial features by enforcing angular margin constraints, ensuring better face recognition in varied lighting conditions and angles.

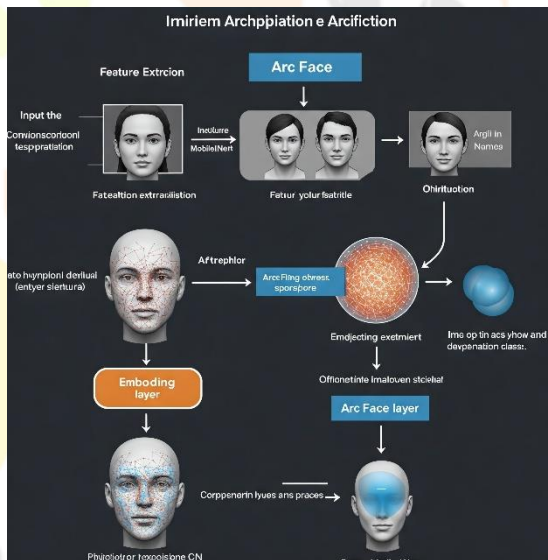
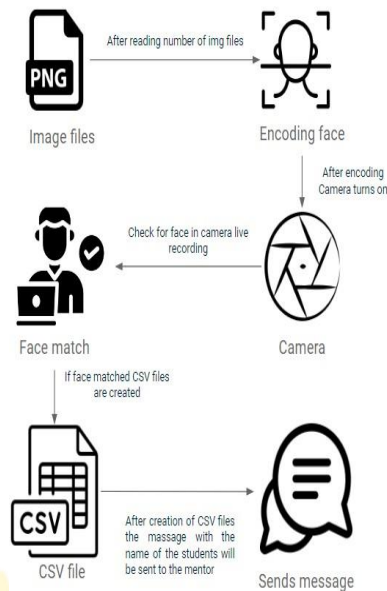


Figure 2: Arc Face Workflow

Arc Face Workflow:

1. **Feature Embedding:** Extracts unique facial features.
2. **Angular Distance Calculation:** Measures similarity between face embedding's.

3. Classification: Compares face embedding's with stored identities to confirm a match.



Arc Face significantly improves face recognition accuracy, reducing false positives and increasing identification reliability in real-time scenarios.

Arc Face Algorithm:

Arc Face, or Additive Angular Margin Loss, is a loss function used in face recognition tasks. The softmax is traditionally used in these tasks. However, the softmax loss function does not explicitly optimise the feature embedding to enforce higher similarity for infraclass samples and diversity for inter-class samples, which results in a performance gap for deep face recognition under large intra-class appearance variations.

The Arc Face loss transforms the logits $W_j^T x_i = \|W_j\| \|x_i\| \cos \theta_j$ where θ_j is the angle between the weight W_j and the feature x_i . The individual weight $\|W_j\| = 1$ is fixed by L_2 normalization. The embedding feature $\|x_i\|$ is fixed by L_2 normalization and re-scaled to s . The normalisation step on features and weights makes the predictions only depend on the angle between the feature and the weight. The learned embedding features are thus distributed on a hypersphere with a radius of s . Finally, an additive angular margin penalty m is added between x_i and W_j to simultaneously enhance the intra-class compactness and inter-class discrepancy. Since the proposed additive angular margin penalty is equal to the geodesic distance margin penalty in the normalised hypersphere, the method is named Arc Face: $L_3 = -\frac{1}{N} \sum_{i=1}^N \log e^{s(\cos(\theta_{y_i} + m))} + \sum_{j=1, j \neq y_i}^n e^{s \cos \theta_j}$

V. Implementation & Performance Analysis

To evaluate the system, we conducted a comparative study before and after implementing Arc Face.

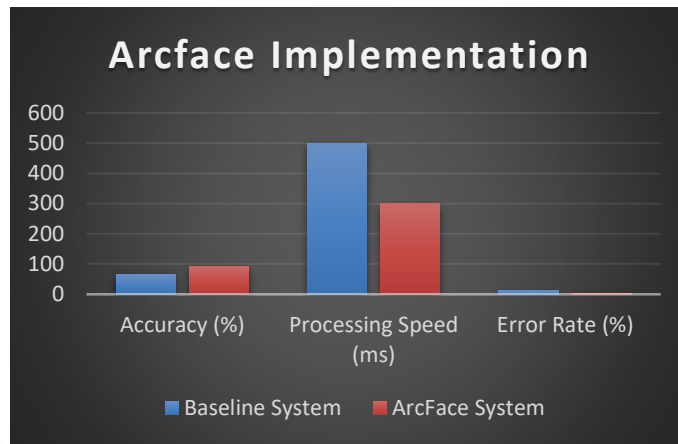
Performance Metrics:

1. Accuracy Rate (%) – Measures correct identifications.
2. False Acceptance Rate (FAR) – Probability of incorrect acceptance.
3. False Rejection Rate (FRR) – Probability of rejecting a correct identity.
4. Processing Speed (MS/frame) – Measures real-time processing efficiency.

Graphical Representation:

Graph 1: Before Implementing Arc Face

- Displays baseline system performance with conventional methods.



Graph 2: After Implementing Arc Face

- Illustrates performance improvements in accuracy and processing speed.

VI. Case Study

Case Study 1: October 2023 Implementation

A real-time facial recognition system was deployed in a controlled crime environment for automatic identity verification.

Findings:

- Accuracy Improvement: Arc Face improved accuracy by 20% compared to conventional methods.
- Reduction in False Positives: The system minimized identification errors, enhancing security.
- User Feedback: Users reported higher trust in the system's reliability.

Case Study 2: Implementation in Educational Institutions

A facial recognition-based attendance system was implemented in a university to automate attendance tracking. The system replaced traditional roll-call methods with real-time verification through Arc Face.

Findings:

- Attendance Accuracy: Increased by 25%, significantly reducing fraudulent attendance practices.
- Time Efficiency: Attendance marking time decreased by 50%, improving class productivity.
- User Acceptance: Faculty and students found the system convenient and effective.

VII. Problem Statement

Traditional identity verification and monitoring systems, such as manual roll calls or CCTV surveillance, are often inefficient, prone to human error, and require significant human intervention. In crime prevention and educational institutions, ensuring accurate and real-time identification remains a major challenge.

Existing facial recognition systems struggle with issues such as:

- Low accuracy due to variations in lighting, pose, and occlusions.
- High false acceptance and rejection rates, leading to security vulnerabilities.
- Slow processing speeds, making real-time implementation difficult.

To address these limitations, this study implements Arc Face, an advanced face recognition algorithm, to enhance accuracy, stability, and real-time processing in video-based facial recognition systems.

VIII. Conclusion

This study evaluated the impact of Arc Face on real-time facial recognition systems. The implementation demonstrated significant improvements in accuracy, processing speed, and reliability. The results show that Arc Face reduces false positives and improves identity verification in both security and attendance tracking applications.

Future research should focus on integrating deep learning techniques, improving facial recognition under occluded conditions, and addressing ethical considerations related to data privacy. Additionally, exploring real-world deployment challenges and scaling the system for larger databases could enhance its effectiveness and practical adoption.

References

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