Computer Vision System for Attendance Tracking
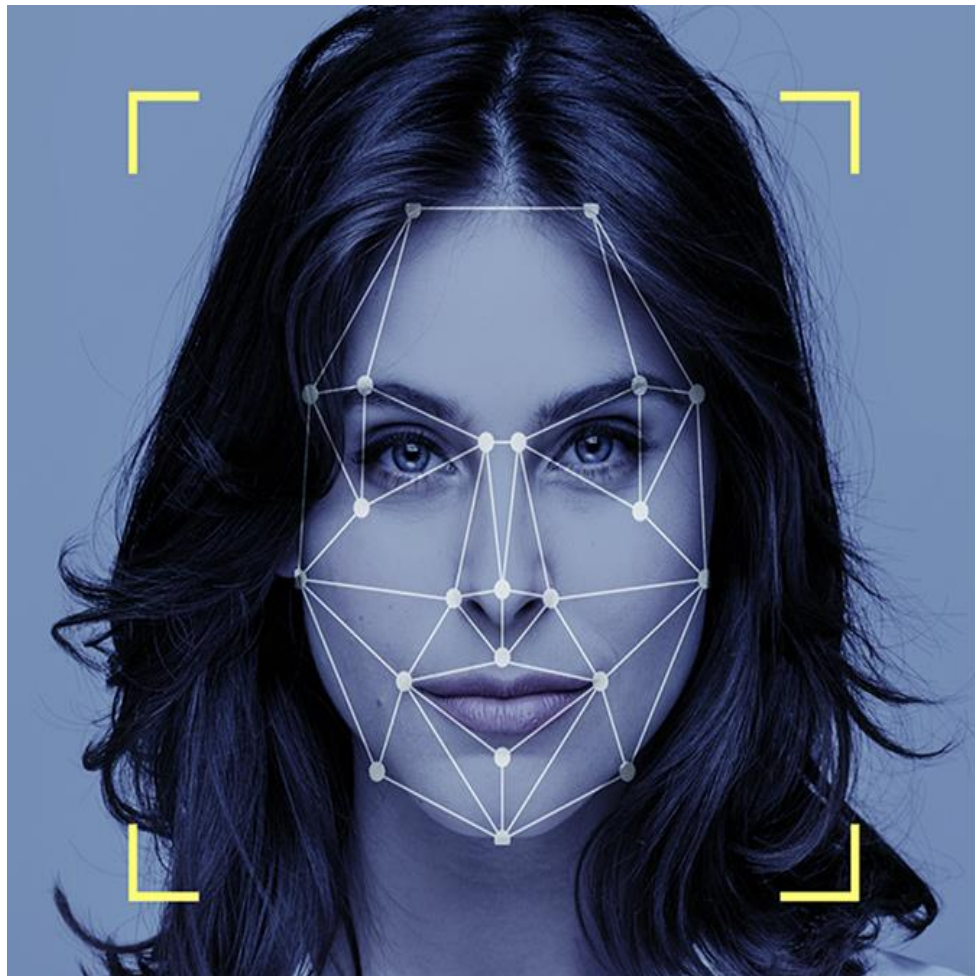
By:

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Agenda

- Introduction

- Overall end-to-end solution

- CV Model

- Addressing Potential Challenges

- Conclusion and Next Steps

- Task contribution and owner

- References

Introduction

- Problem overview and Current situation
- Ensuring Privacy & Security
- Stakeholders and Beneficiaries

Your attendance is not optional

Problem overview and Current Situation

- Presently, attendance tracking is either **non-existent or manually** conducted, leading to potential inaccuracies and inefficiencies
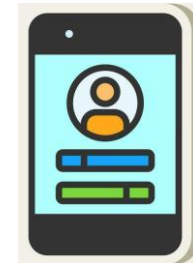
ASU MSBA Current Situation

No attendance

Paper

Other Situation

RFID

APP

Our CV-based Attendance Solution

We propose to employ Computer Vision (CV) technology to automate the attendance process using facial recognition.

Operational Flow:
- Cameras installed in classrooms capture images at the start and end of each session.
- Facial recognition software identifies students and records attendance automatically.
- The system integrates seamlessly with existing administrative systems for real-time updates.
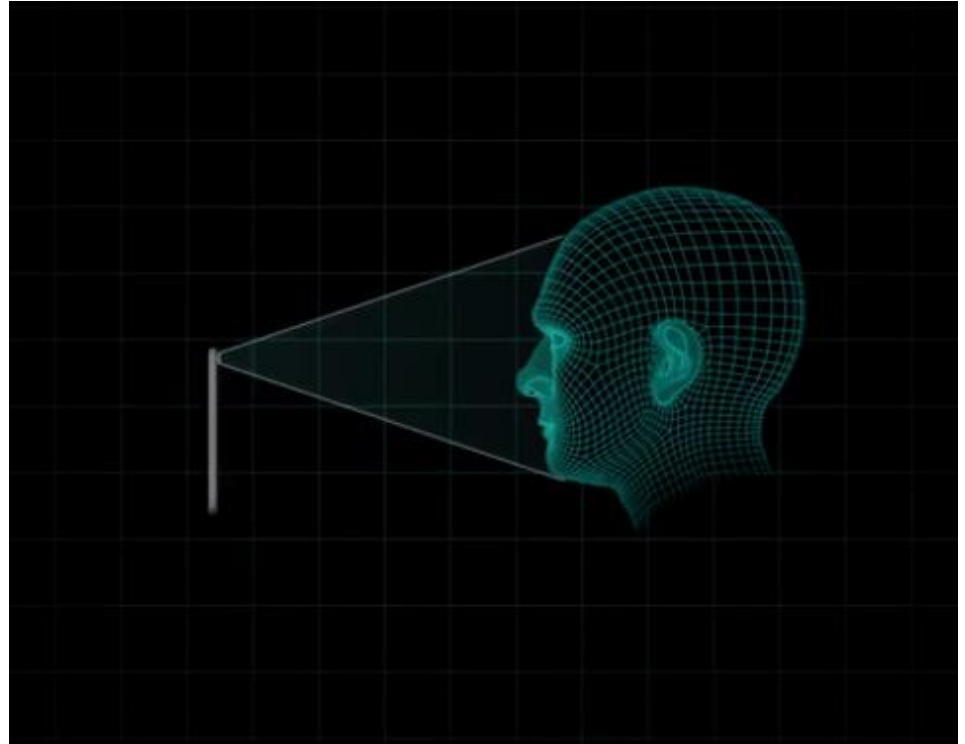
Ensuring Privacy and Security

Ensure all processes **comply with privacy laws** and **ASU's privacy policies**.

Data Handling

Compliance

Mitigation Strategies

Implement **strict data handling protocols** to ensure data security and protect student privacy.

Measures like **data encryption**, **limited access protocols**, and **continuous monitoring** to address potential privacy concerns.
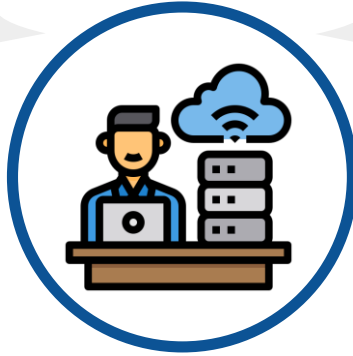
Stakeholders and Beneficiaries

Faculty

Reduced **administrative burden**, **more accurate** and **fair evaluation** of student attendance.
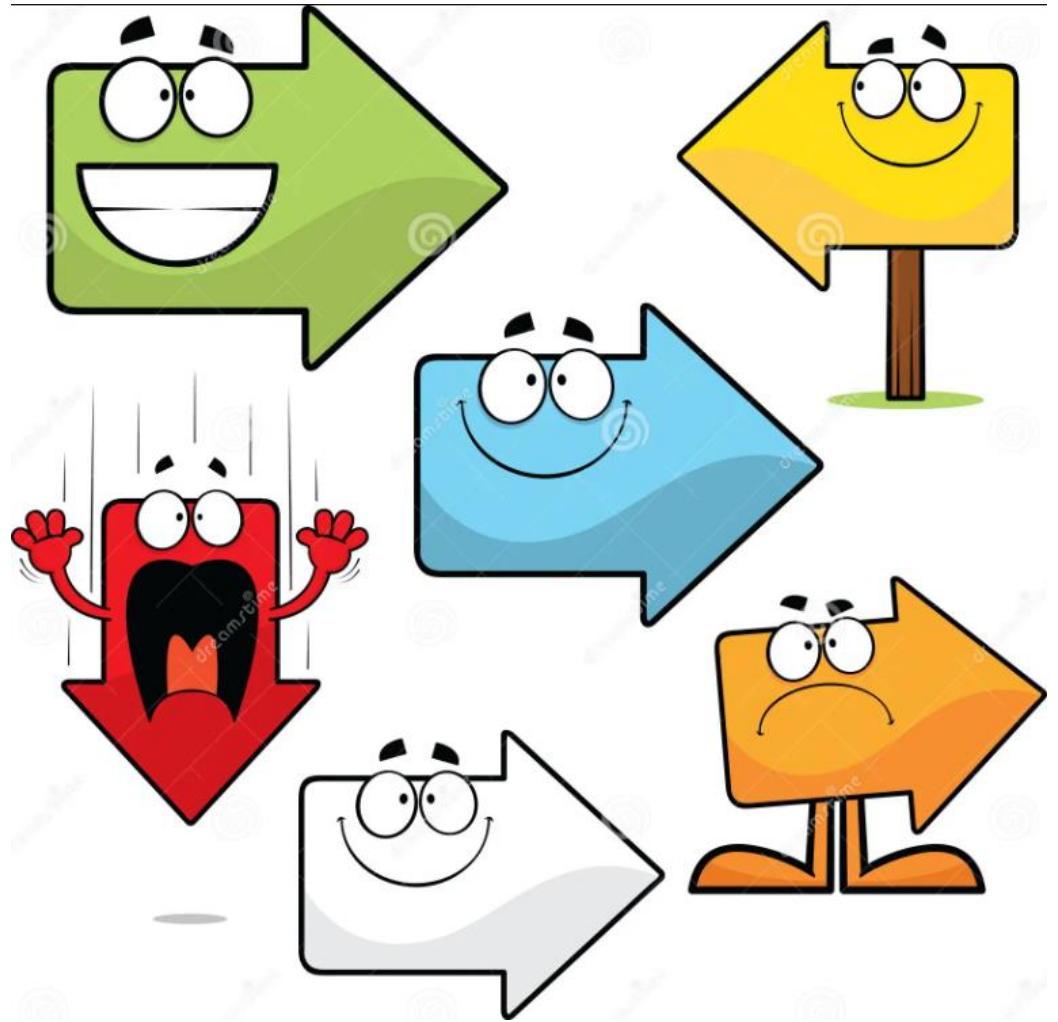
Admin Staff

Streamlined processes, **reduced errors** in attendance data, and **improved efficiency**.

Students

Fair and **transparent recording** of attendance and enhance **student engagement** in learning process for **better career.**

End-to-end Solution

Overall end-to-end solution (1/2)

Orientation Photography	Cohort Cataloging	Camera Setup	Application Activation
Students attending mandatory orientation at the beginning of school year have their **official picture taken**.	Pictures of each student are **recorded in MSBA database** and sorted into cohorts.	Install and **calibrate cameras at each classroom** utilized by MSBA Department.	**Instructor will turn on application** installed in classroom terminal.

Overall end-to-end solution (2/2)

Facial Recognition	Attendance Logging	Attendance Reporting

Camera detects student face and matches it with cohort.

Upon affirmative match of face detection with cohort, student's **ID number** along with **time stamp is recorded** in attendance spreadsheet.
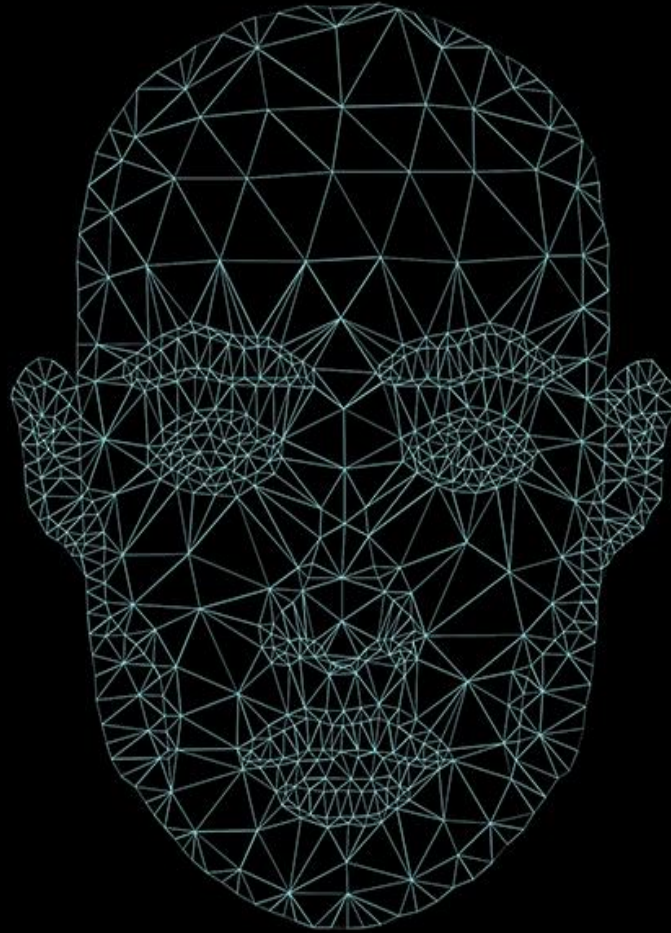
At the end of each class period, **instructor can manually email spreadsheet** to their respective attendance recorder (i.e, Teaching Assistant, course grader, self, etc)

*Each instructor may use attendance record to their discretion based on individual class attendance policy
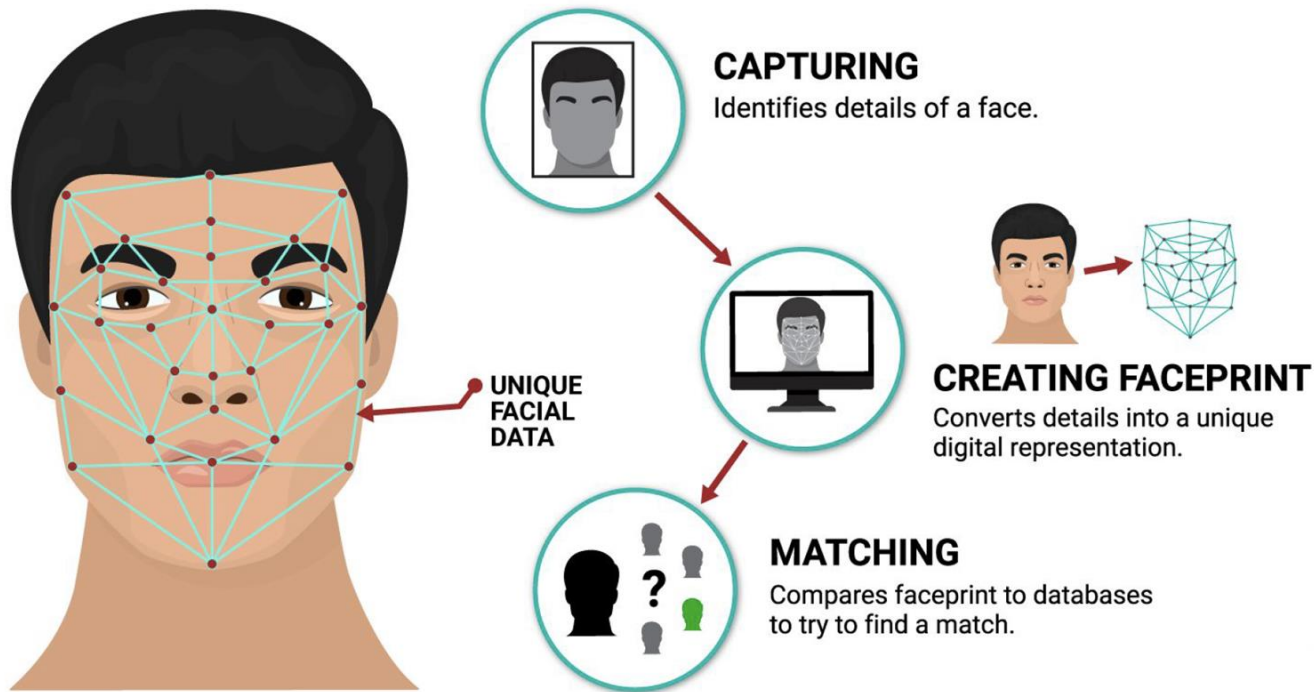
CV Model

Why CV?

➜ CV is vital for precise face detection and recognition in webcam video frames.

➜ Manual tracking is error-prone and labor-intensive, especially in large classes.

➜ RFID systems are expensive and lack universal adaptability.

➜ CV enables efficient, scalable, and real-time tracking without extra hardware.

CV Model Overview

UNIQUE FACIAL DATA

CAPTURING
Identifies details of a face.

CREATING FACEPRINT
Converts details into a unique digital representation.

MATCHING
Compares faceprint to databases to try to find a match.

CV Model Method

Description of CV Model

- CV model based on face_recognition library.
- Uses deep learning for face detection and recognition
- Utilizes pre-trained models from dlib for feature encoding and comparison.

Model Training Details

- Face recognition model pre-trained on large face dataset
- Internally validated for accurate detection and recognition.
- Success metrics: accuracy, precision, recall, F1-score.

External Validation and Monitoring

- External validation conducted on separate dataset for real-world performance evaluation.
- Post-deployment monitoring for performance degradation.
- Updates provided as needed.

Outcome-Action Pairings

- TP: Mark attendance for recognized students
- TN: No action required
- FP: No attendance marking for unrecognized faces
- FN: No attendance marking for missed detections

CV Model Method

Bias Issues and Mitigation

- Address bias issues by using diverse datasets for training.
- Ensure representation of different demographics to mitigate bias.

Lessons Learned

- Adapt to challenges and refine solution based on feedback and real-world testing.
- Flexibility and continuous improvement are key to success.

## Limitations & Future Enhancements

- Limitations: Difficulty in recognizing faces under varying lighting or occlusions.
- Future enhancements: Fine-tuning on specific datasets, additional preprocessing techniques for improved robustness.

Additional Points

- Address privacy concerns with facial recognition technology Ensure compliance with regulations and ethical standards.
- Maintain regular communication with stakeholders for successful implementation.

Model Performance
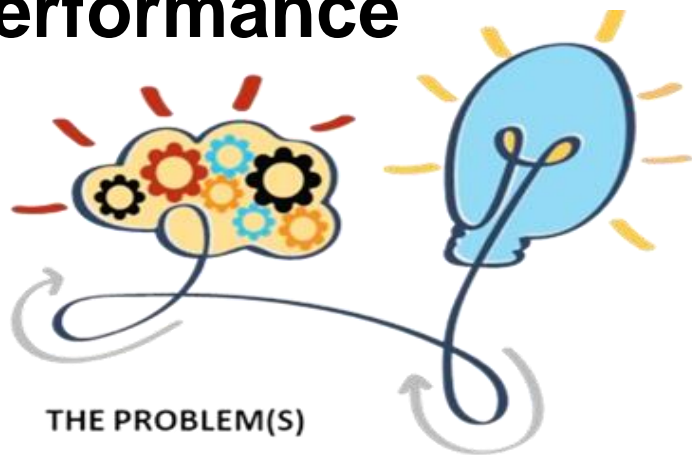
- Inadequate number of training images hindered learning process that led to poor accuracy earlier.
- Lack of diversity in images (# images in different angles, lighting effect) affected the model generalization.
- Use of student IDs as labels caused labeling issues along with storing multiple images of the same student as sub-labels led to inconsistencies in our model.

THE SOLUTION(S)

- Augmented training data with thousands of diverse human images
  - Included images from various angles and lighting conditions
  - Aimed to improve generalization
- Revamped labeling system
  - Assigned unique serial numbers to each image
  - Streamlined labeling process
  - Mitigated inconsistencies
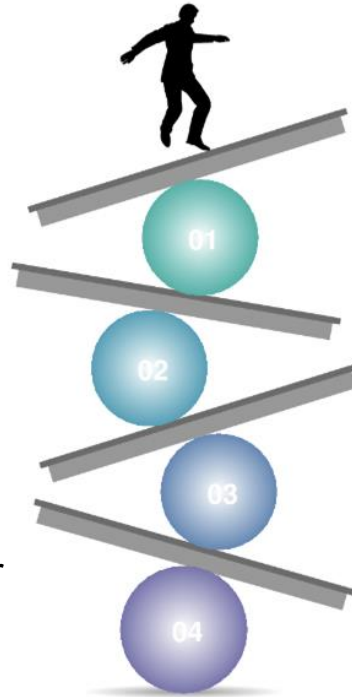
Addressing Potential Challenges
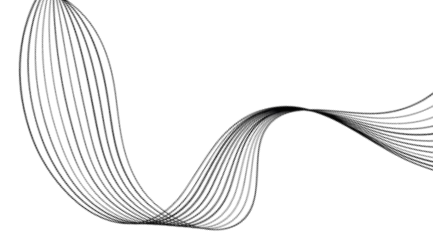
Accuracy and Bias
Diverse training datasets, update algorithms regularly, and conduct frequent accuracy checks.

Privacy and Consent
Ensure transparency and consent, comply with laws, use strong encryption, and implement strict access controls.

Technical Issues & Reliability
Invest in quality hardware, ensure regular maintenance, and establish manual overrides or backups.

Integration with Existing System
Design for compatibility and use middleware or APIs for smooth data exchange.

01

02

03

04

Conclusion & Findings

- Aims to ensure real time & **accurate attendance** data.

- Need for a **standardized system**.

- Offers a streamlined, accurate approach to managing class participation, **benefiting all stakeholders.**

- Presents a **cost-effective and practical solution** for educational institutions.

- Positive **impact on learning** environment leading to **student empowerment & accountability**.

Findings

Efficiency Gains

Enhance Student Engagement

Security & Integrity

Resource Optimization

Long-term Sustainability

Next Steps

Continuous Improvement

Enhance CV-based attendance system based on user feedback, refining algorithms, improving integration, and enhancing user experience.

Compliance & Regulations

Stay updated on privacy regulations, conduct regular assessments, update protocols, and maintain transparency with stakeholders.

Expansion to other Programs

Expansion Consider expanding the use of the CV-based attendance system to other programs within the university.

Research & Development

Explore emerging technologies for attendance tracking, such as biometric authentication, blockchain for secure data management, and IoT devices for automated tracking.

References

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2. https://trackobit.com/blog/reasons-to-use-facial-recognition-attendance-system

3. https://www.56armour.com/blog/facial-recognition-technology-revolutionising-attendance-management-in-companies

4. https://www.rhombus.com/pricing/#pricing