Facial Recognition for Student Engagement

Jiachun Guo, Jianan Wu, Yifeng Tan, Sasanka Munasinghe

TABLE OF CONTENTS

01 Project Background

02 Methodology for Evaluating Student Engagement

03 Model Selection and Training

04 Analysis of Student Engagement

05 Conclusions and Future Directions

01.

Project Background

Importance of Student Engagement

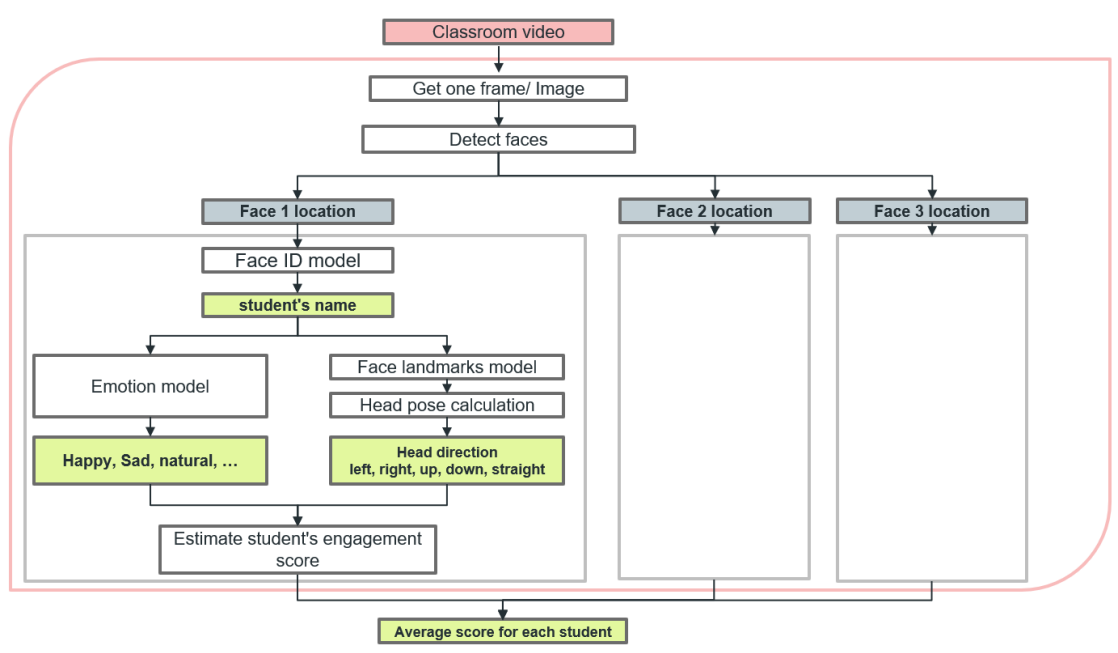
- Active student engagement is crucial for learning outcomes , academic performance, and overall satisfaction .
- Traditional assessment methods may lack objectivity or accuracy , such as teacher subjective observation or simple attendance records, failing to provide a comprehensive understanding of student engagement.

02.

Methodology for Evaluating Student Engagement

Facial Recognition

- **Facial recognition technology** offers an objective, data - driven method to assess student engagement.
- We employ **face ID recognition** , **emotion recognition** , and **facial orientation recognition** models to analyze the engagement of each student.
- We can **install a camera** in a classroom to capture images of each student, enabling **real - time engagement** prediction.



03.

Model Selection and Training

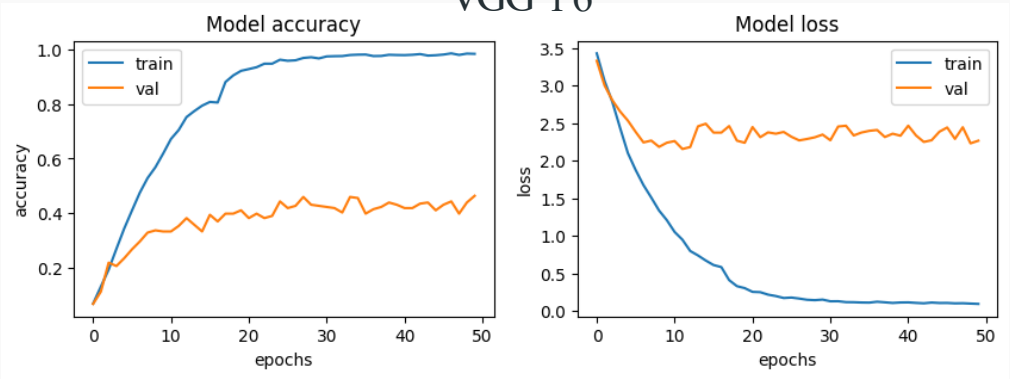
Face ID Recognition

- Dataset : Face Recognition Dataset https://www.kaggle.com/datasets/vasukipatel/face-recognition-dataset/data
- Celebrity image dataset with 31 classes with 2562 images

Augmentations:
- Shear transformations
- Zoom
- Horizontal flip
- Rotation
- Hight shift
- Width shift
- Brightness

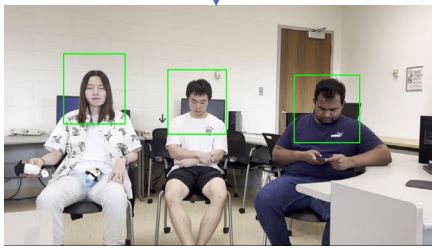
Model architecture	Train accuracy	Test Accuracy
VGG 16	98.71%	44.29%
VGG 19	78.86%	36.07%
Mobilenet v2	87.96%	35.25%
Custom CNN	99.88%	44.26%

VGG 16



Face ID Recognition

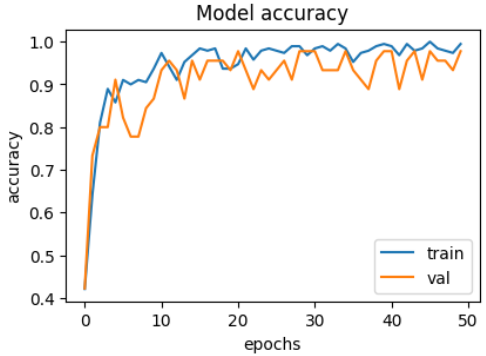
Face detection model
OpenCV neural network model

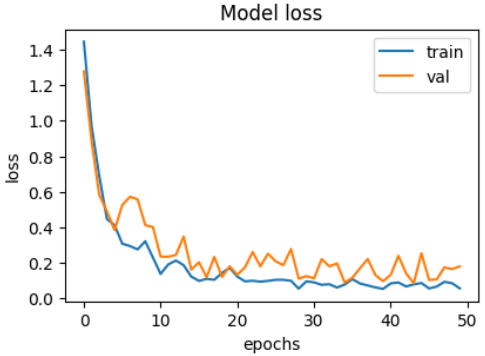


Face ID model
Dataset : Real Images
Architecture : VGG16 + custom layers
Loss Criterion : Cross Entropy

```
1/1 [==============================]
Predicted Class: Sasanka
Confidence Level: 0.99815303
```

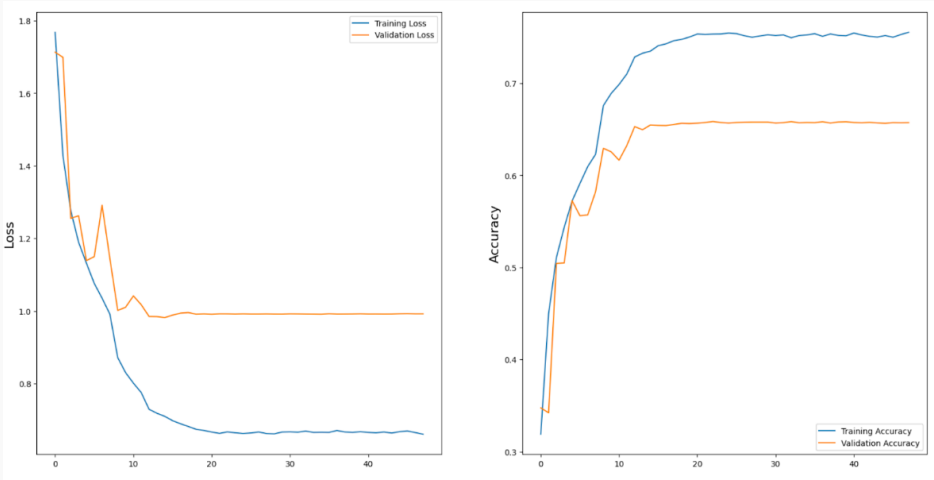
John | Migara | Sasanka | Supun | Teddy

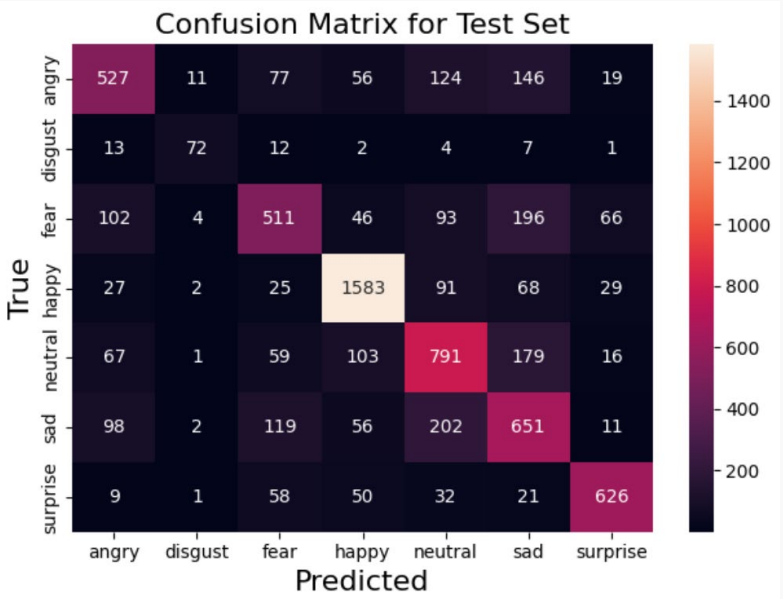




Emotion Recognition

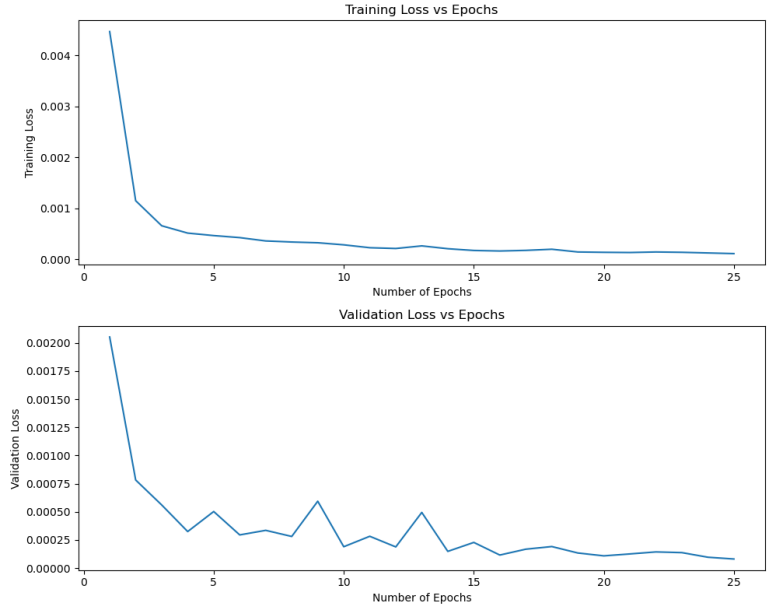
- **Dataset** : Face Expression Dataset
  https://www.kaggle.com/datasets/jonathanoheix/face-expression-recognition-dataset
- **Model**: Custom CNN
- **Loss Criterion**: Cross Entropy





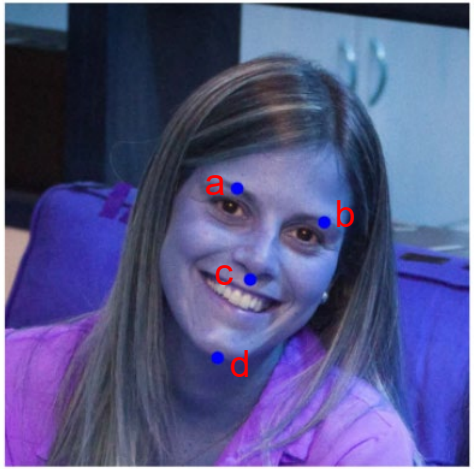
Facial Landmarks Prediction

- Dataset : LaPa
- https://github.com/JDAI-CV/lapa-dataset
- Architecture: MobileNetV2
- Loss Criterion: Mean Square Error



Facial Orientation Estimation

a :left eyebrow center
b: right eyebrow center
c: nose tip
d: chin
m: the midpoint of ab

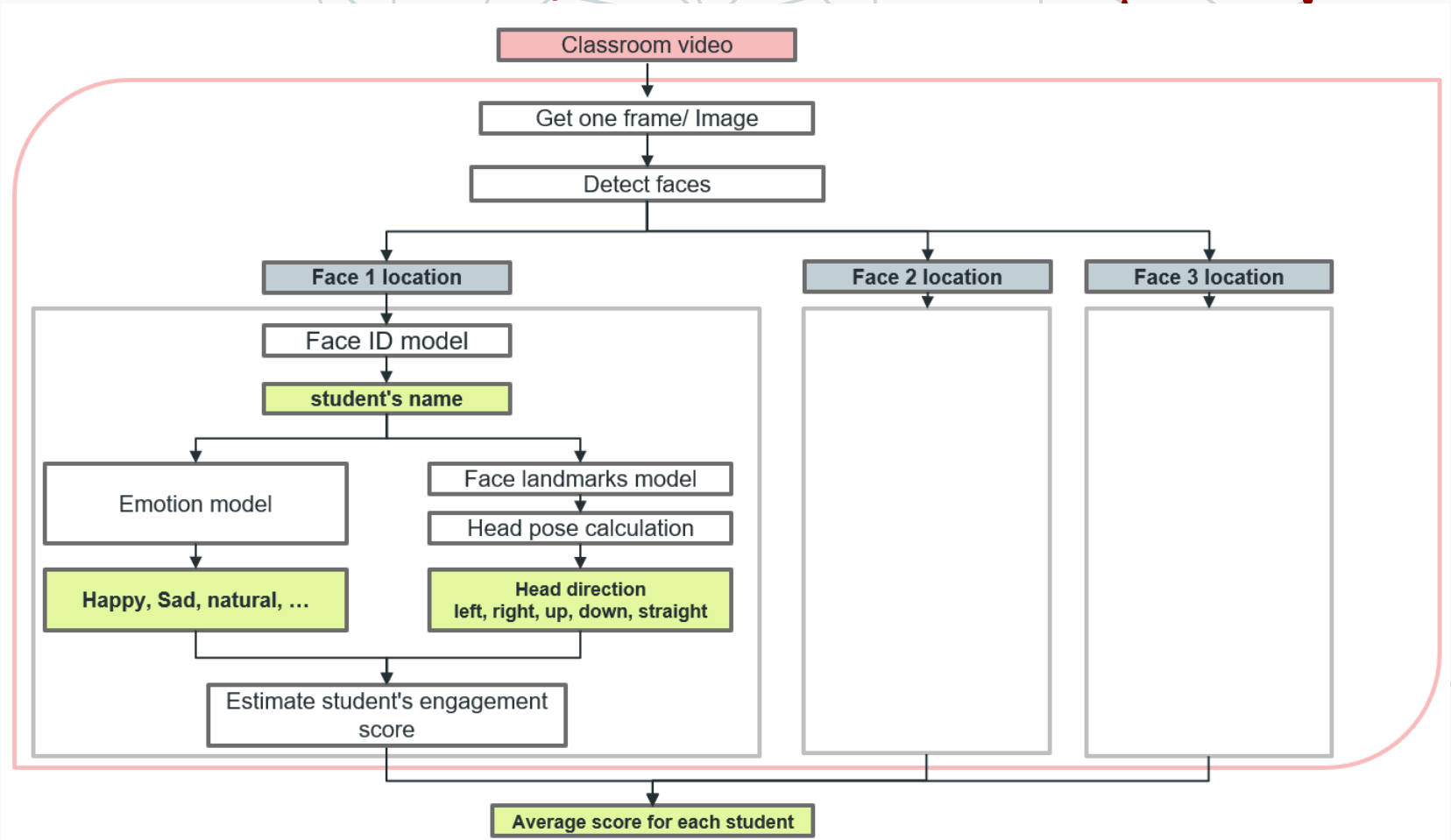


Criteria	Facial Orientation
ac / bc < 0.95	Left
ac/ bc>1.05	Right
Otherwise	Forward
cd/cm>1.15	Upward
cd/cm<0.85	Downward
Otherwise	Forward

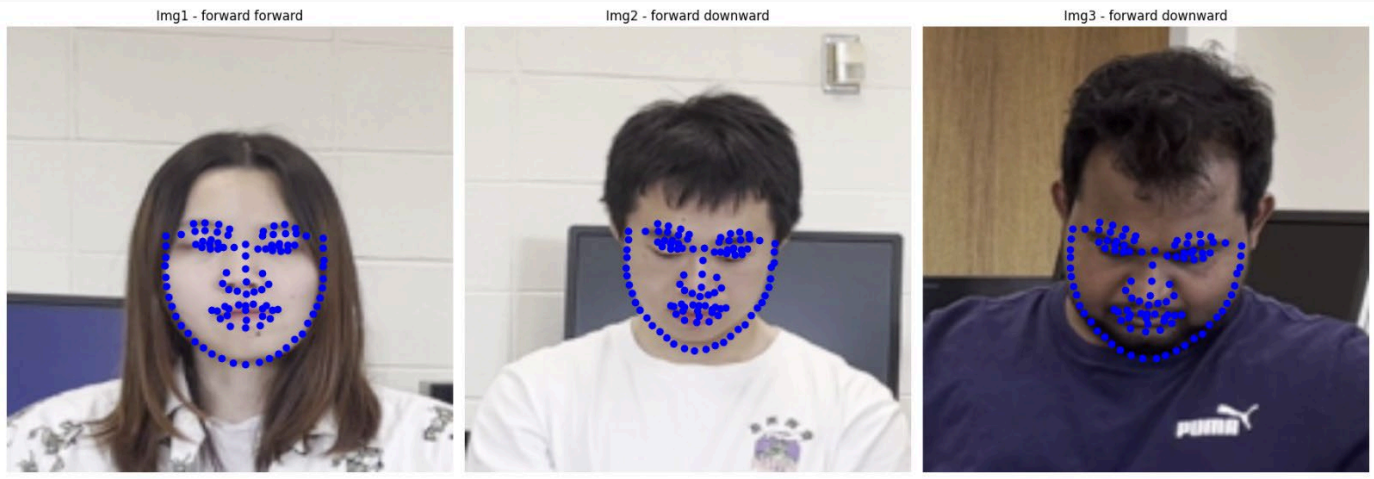
(face_lr , face_ud)

04.

Analysis of Student Engagement


Classroom video
Get one frame/ Image
Detect faces
Face 1 location
Face 2 location
Face 3 location
Face ID model
student's name
Emotion model
Face landmarks model
Head pose calculation
Happy, Sad, natural, …
Head direction
left, right, up, down, straight
Estimate student's engagement score
Average score for each student

Name, Emotion and Facial Orientation



```
1/1 [==============================]
Predicted Class: Teddy
Confidence Level: 0.9991215
1/1 [==============================]
Emotion: neutral
head_lr: forward || head_ud: forward
```

```
1/1 [==============================] -
Predicted Class: John
Confidence Level: 0.97767764
1/1 [==============================] -
Emotion: angry
head_lr: forward || head_ud: downward
```

```
1/1 [==============================]
Predicted Class Sasanka
Confidence Level: 0.85546094
1/1 [==============================]
Emotion: sad
head_lr: forward || head_ud: downward
```

Engagement Rating Criteria

Emotion Combination

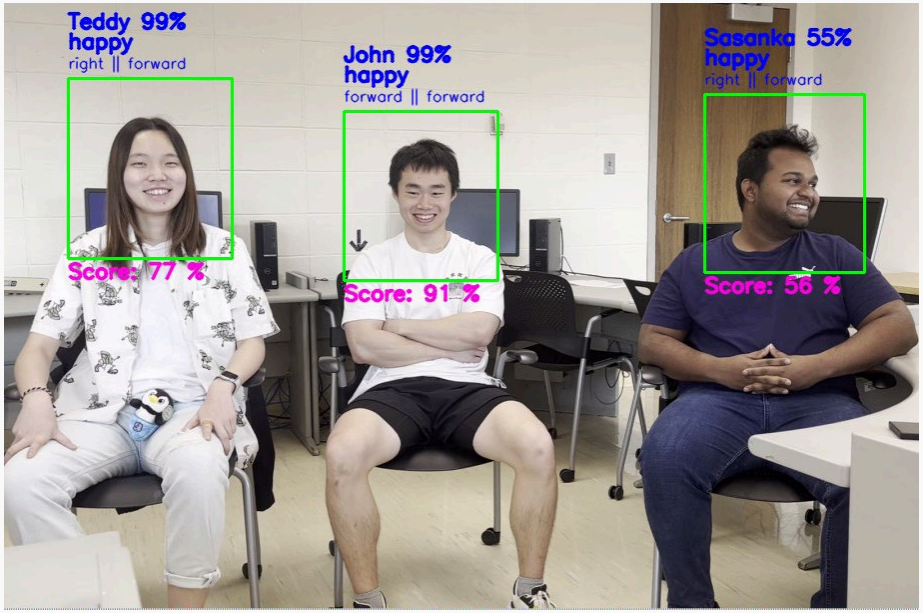
Emotion	Combined Emotion
angry, fear, disgust	angry
happy, surprise	happy
neutral, sad	neutral

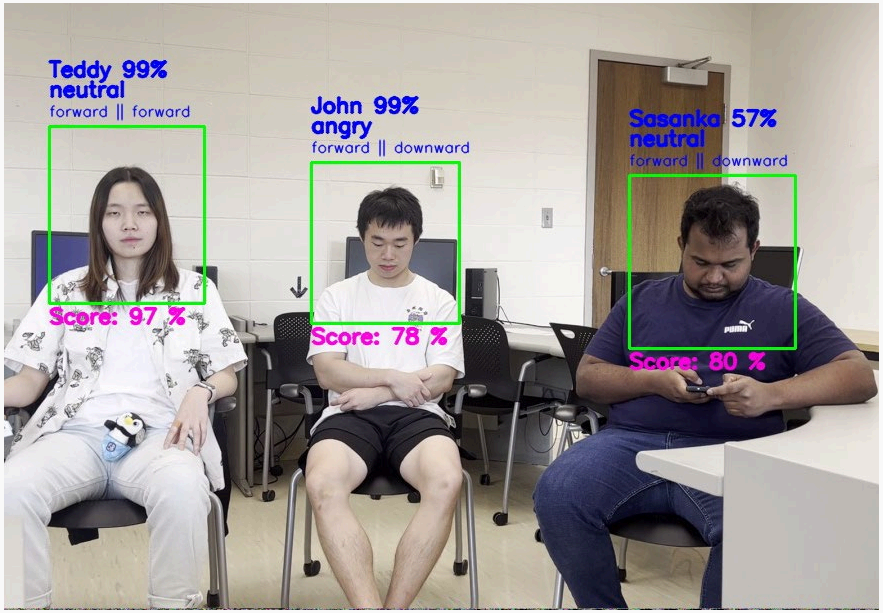
Score per Frame

initial value of "score“ = 10

Condition	Score Adjustment
Emotion is 'angry'	-1
Emotion is 'happy'	-1.5
Emotion is 'neutral'	0
Head_lr is 'left' or 'right'	-2
Head_lr is 'forward'	0
Head_ud is 'upward' or 'downward'	-2
Head_ud is 'forward'	0

Engagement Score Prediction

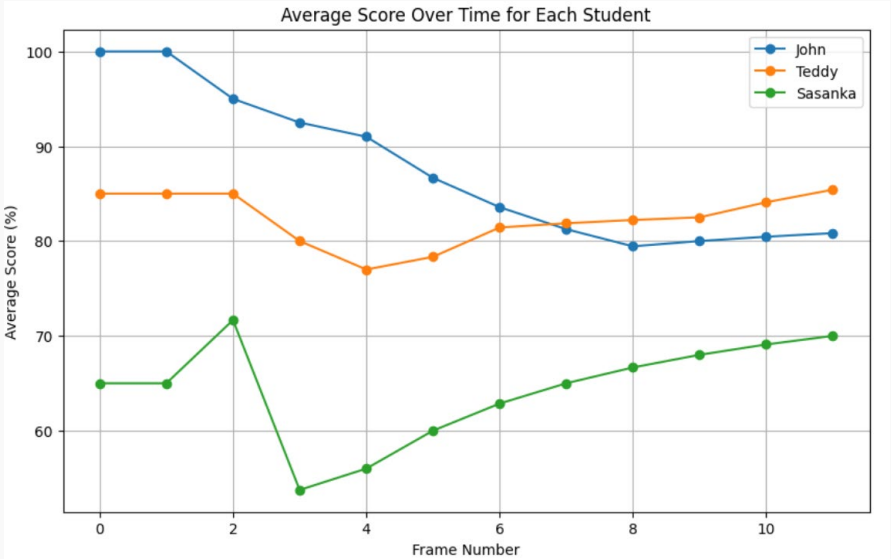




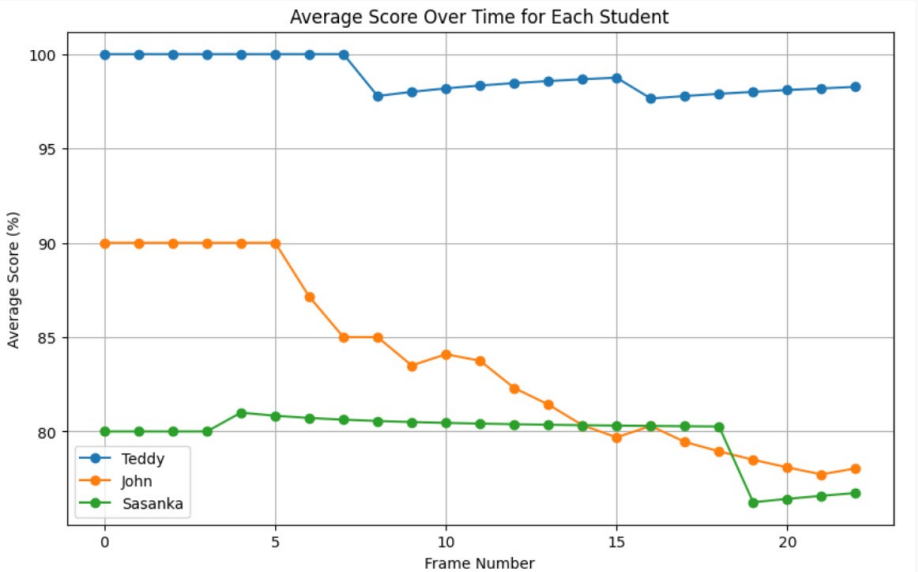
Average Score Over Time

Average Score = Current Cumulative Score / (10 * Current Frame Number)

Video 1



Video 2



05.

Conclusions and Future Directions

Conclusions and Future Directions

Conclusions:

- Objective assessment is crucial for improving the teaching methods and enhancing the learning experience .
- Our project demonstrates the effectiveness of facial recognition technology in assessing student engagement, offering valuable insights for educators.

Future directions:

- Predicting emotions is challenging , requiring more effective models to improve accuracy in emotion prediction.
- Using real classroom student expressions as a dataset (current datasets often contain exaggerated facial expressions not representative of real classroom scenarios.).
- Exploring more sophisticated criteria to improve the accuracy and robustness of facial orientation assessment (our method relies on only four face landmarks to determine facial orientation).

THANKS

Do you have any questions?