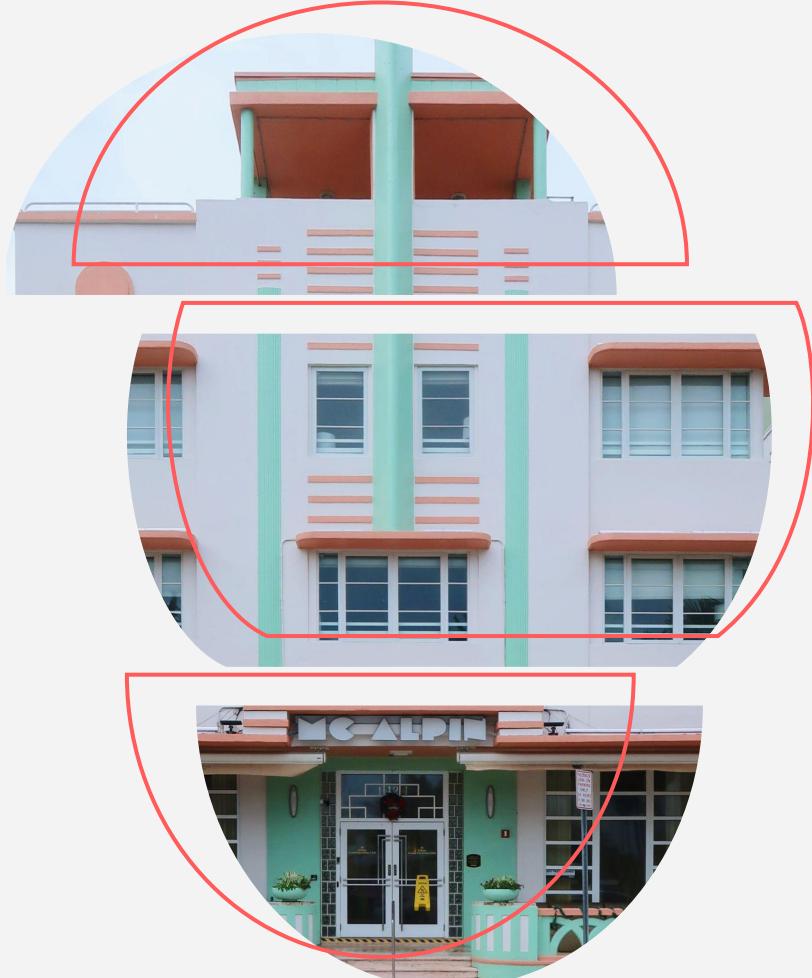


PRODUCTION/ SET DESIGN

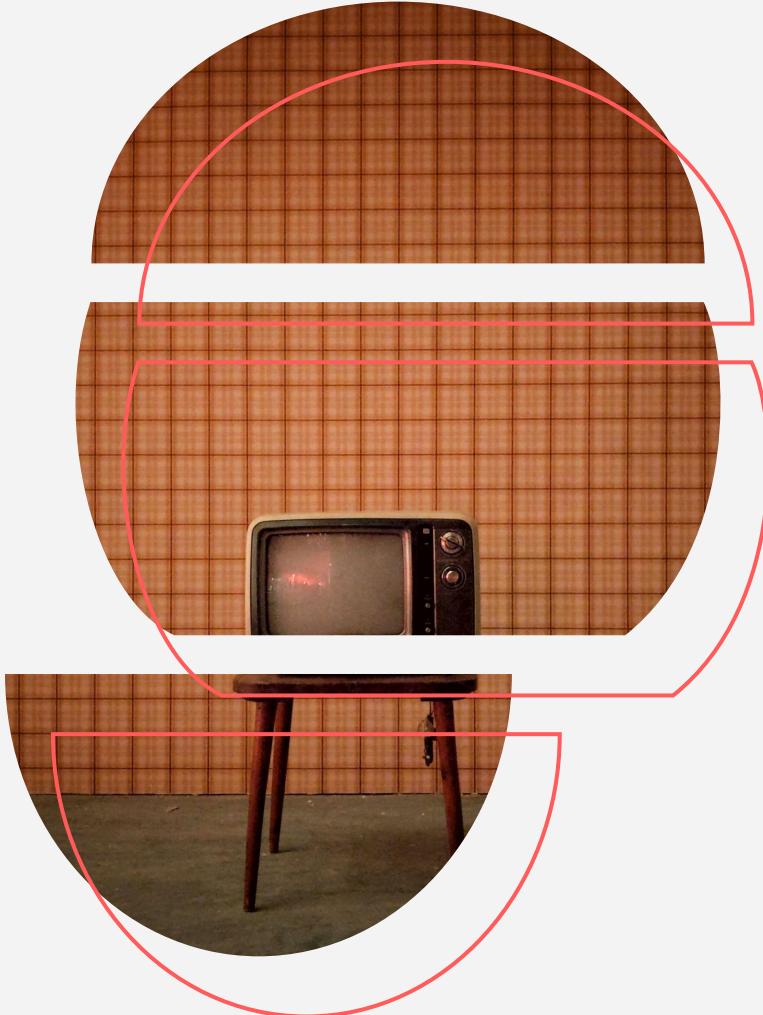
PREDICTING EMOTION EVOKED BY AN 'IMAGE'
&

DESIGNING AN ENVIRONMENT AROUND THE EMOTION



01

Use Case Why detect?





**eg. SET DESIGN /
Wes Anderson**

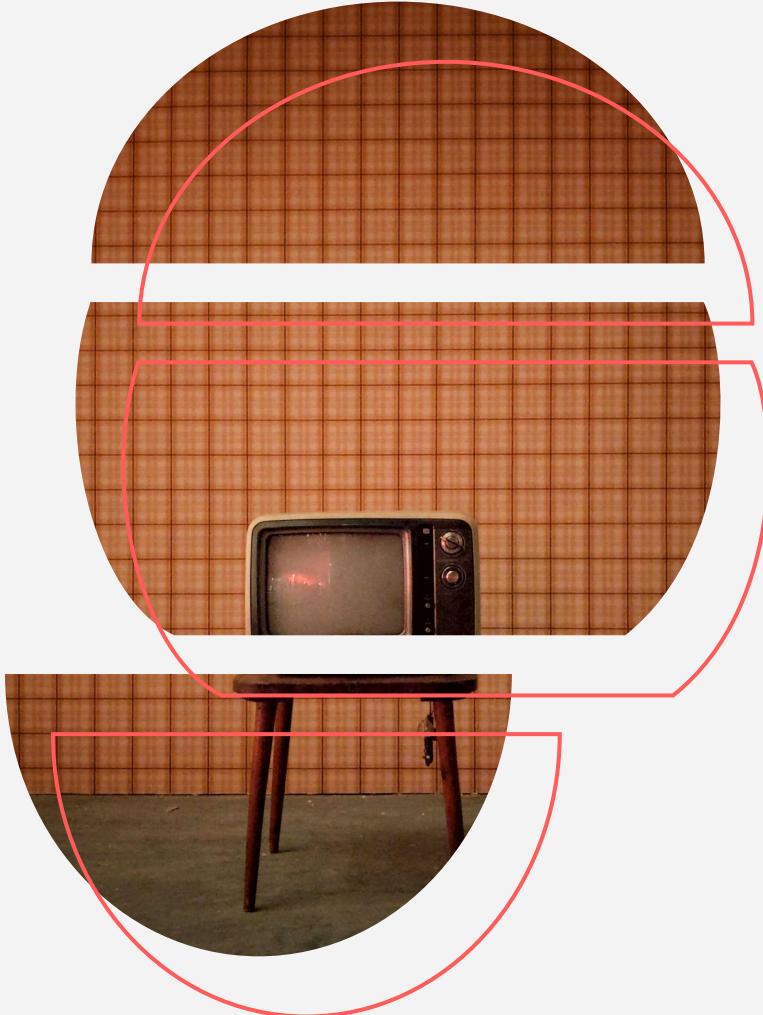
GOAL

- Detect an emotion evoked by an image (to then)
- Use image to associate environment with that emotion
- Use cases: environment / production / set design



02

Methodology Data/ Models



DATASET

WikiArt

Emotions

Psychological Study

20 annotators
More than 4000 artworks

20 emotions

Grouped as: Positive / Negative / Mixed
gratitude, happiness, humility, love, optimism, trust / anger, arrogance, disgust, fear, pessimism,
regret, sadness, shame / agreeableness, anticipation, disagreeableness, shyness, surprise, neutral

4 Data Sets

Images scraped
4 DF: 1 probability & 3 presence/absence of emotions

ARTWORKS

Images

anticipation



anticipation



happiness



trust



disgust



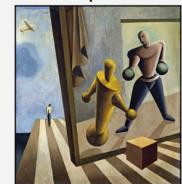
surprise



fear



surprise



trust



surprise



fear



happiness

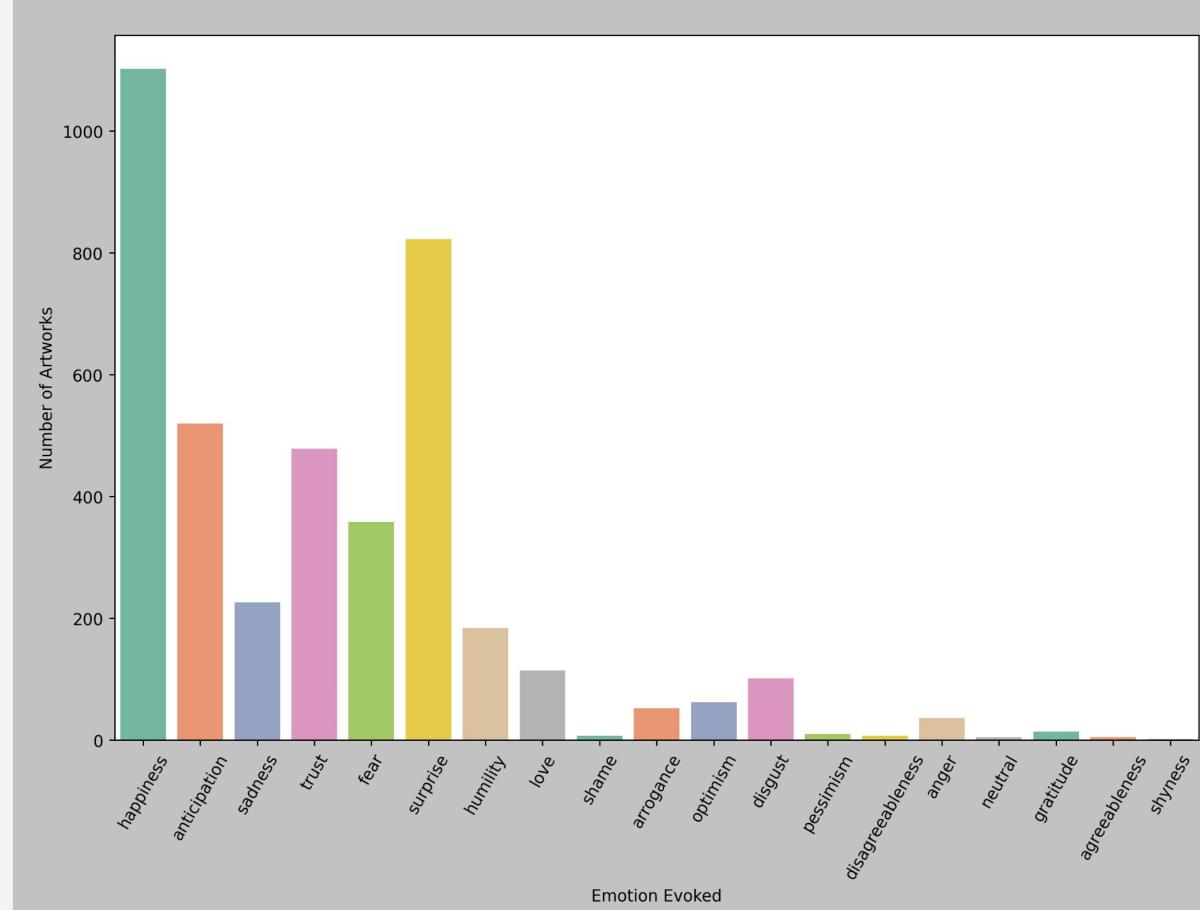


happiness



TARGET Distribution

Top Emotion Evoked



WORKFLOW Models Built

1. Multi class, multi label

2 versions

Accuracies: ~25% & ~30%

2. Multi class, single label

Accuracy: ~27%

3. Binary class

First, top 2 emotions: happiness & surprise. Acc: ~85%
Then, positive & negative emotions. Acc: 71% (test acc)

4. Three class

Positive, Negative, Mixed Emotions
(as per authors of study) Acc: 68%

MODELS

Tools

Multi class models

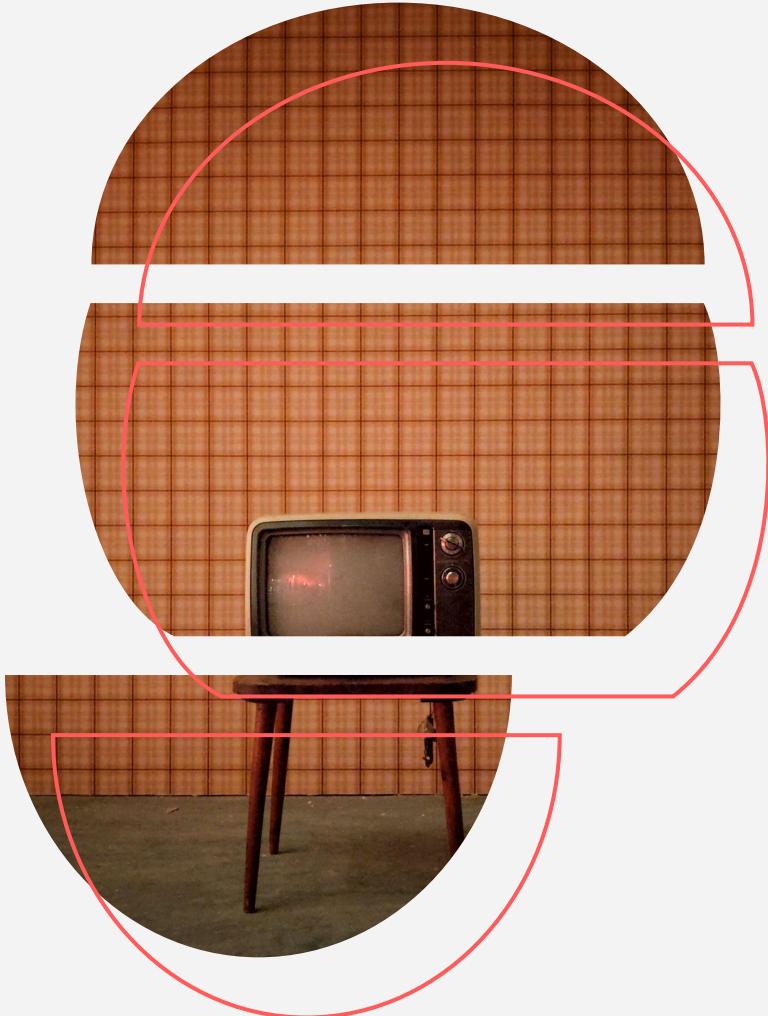
- Data Aug. + MobileNet (w Dropout + L2)
 - Simple 1 layer
 - Transfer Learning with VGG16

Binary + Three class models

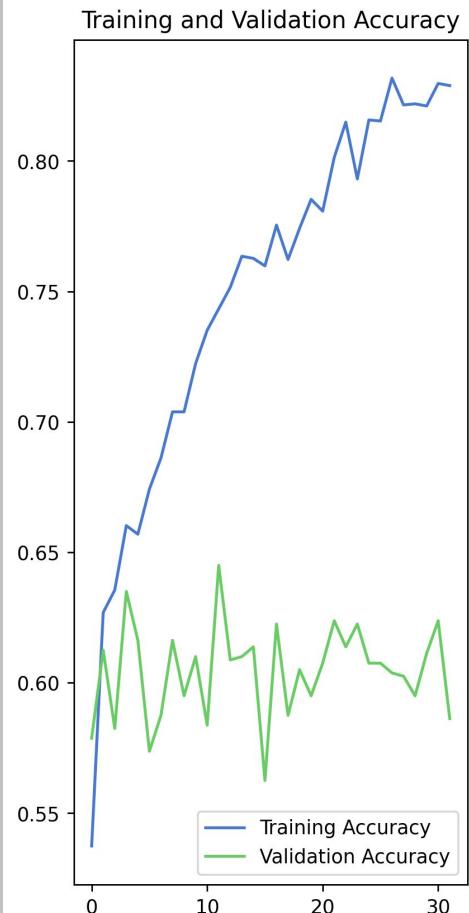
- Simple MobileNet with 2 Dense Layers, Data Aug (+EarlyStopping)

03

Results Data/ Models



Three - Class Model



3-class Model

Baseline Accuracy: 42%
(2 Dense layers)

Model Train Accuracy: 75%
Model Val Accuracy: 60%
Model Test Accuracy: 68 %
Model F1 score: 65%

METRICS Accuracy

Misclassifications

Predicted: positive. Actual: mixed



Predicted: mixed. Actual: positive



Predicted: positive. Actual: negative



Predicted: positive. Actual: mixed



Predicted: negative. Actual: positive



Predicted: positive. Actual: mixed



Predicted: mixed. Actual: positive



Predicted: positive. Actual: mixed



Predicted: positive. Actual: negative



Predicted: mixed. Actual: positive



Predicted: mixed. Actual: positive



Predicted: positive. Actual: mixed



Predicted: mixed. Actual: positive



Predicted: positive. Actual: negative



Predicted: mixed. Actual: positive



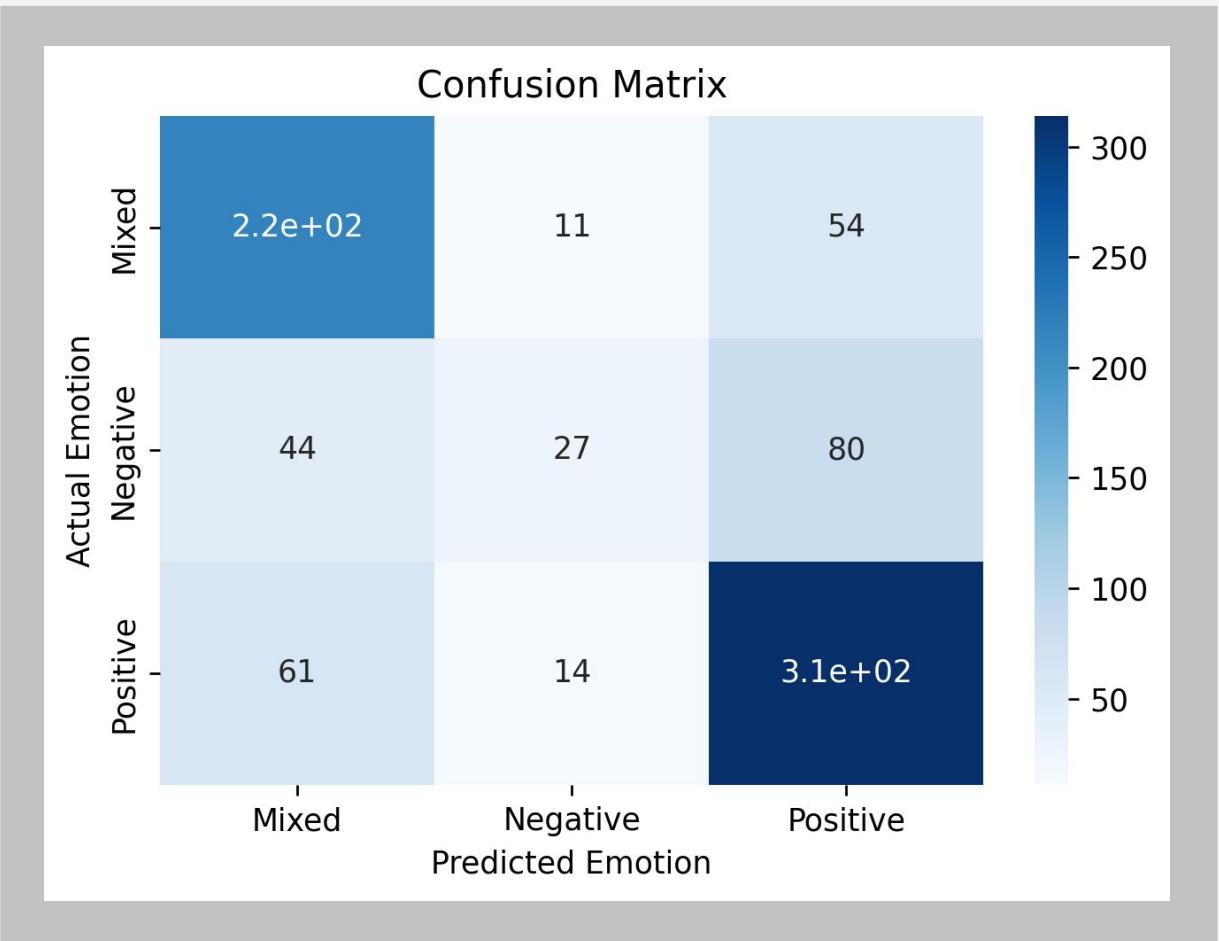
Predicted: mixed. Actual: positive



3-class Model

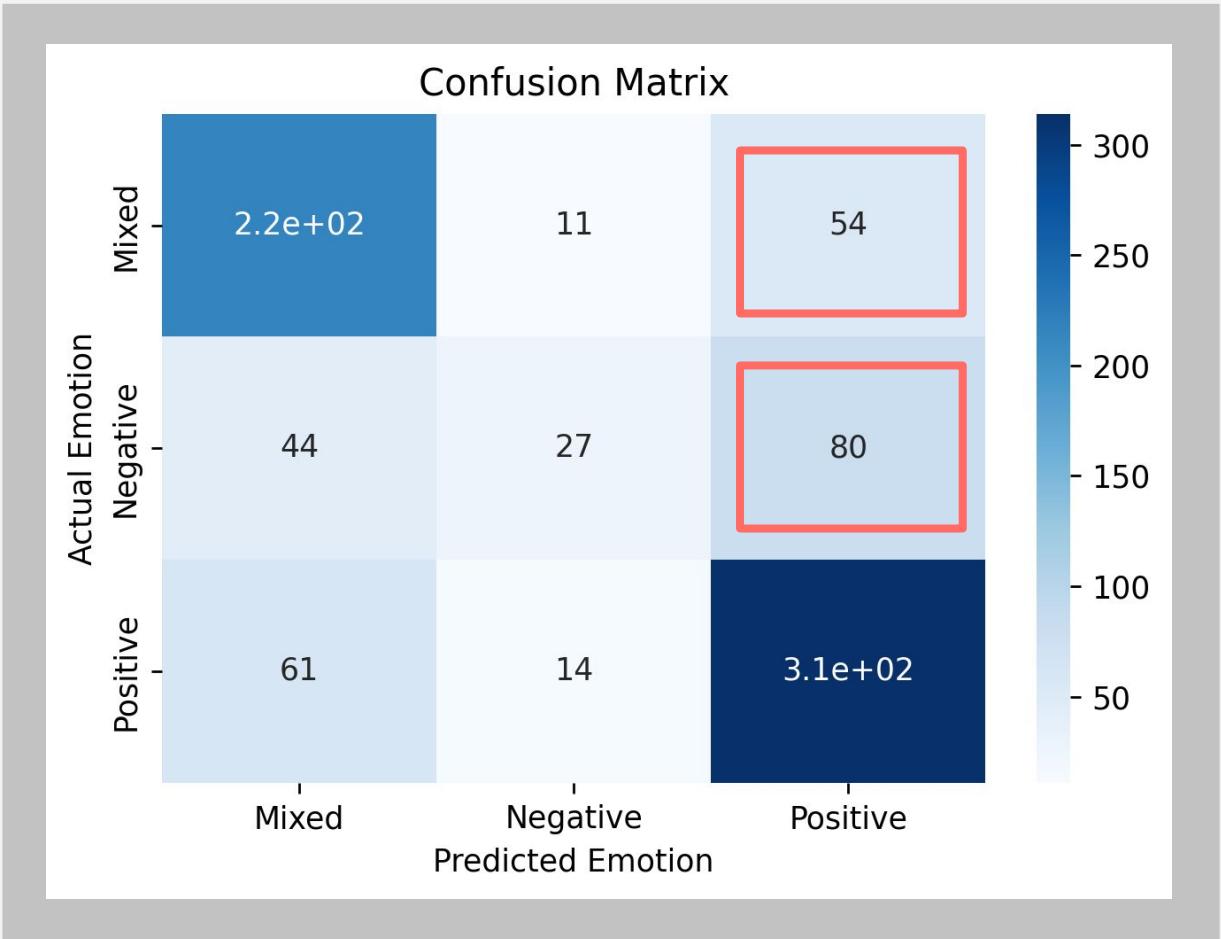
Confusion Matrix

METRICS
Confusion



3-class Model

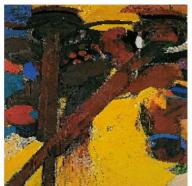
Confusion Matrix



METRICS
Confusion

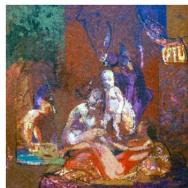
Predict **Positive** Actual **Negative**

Predicted: Positive. Actual: Negative



Predicted: Positive. Actual: Mixed

**Predict Positive
Actual Mixed**



This image most likely evokes mixed emotions with a 67.84 percent accuracy.



Prediction: Mixed

Orozco, Omnisciencia, 1925

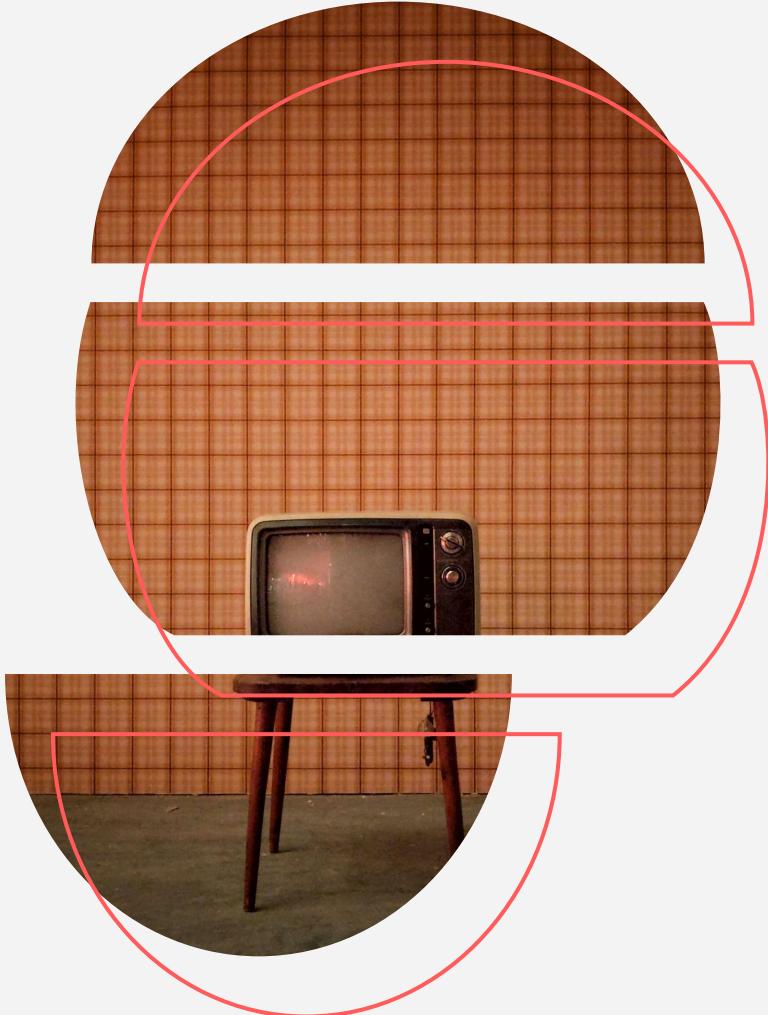
This image most likely evokes mixed emotions with a 67.84 percent accuracy.



Prediction: Mixed
Anonymous Art,
From my bedroom

04

Conclusions & Further Work



3 - CLASS Conclusions

01

Bright Colors

Predicts: Positive
Actual: Could be anything

02

Gray/Muted Color

Predicts: Negative
Actual: Could be anything

03

Realism / Whole White bodies

Predicts: Positive
Actual: Depends on context

04

Face Distortions / Cut / Crop

Predicts: Mixed
Actual: Negative

05

Uncertainty

Predicts: Mixed
Actual: Negative

06

Too much in scene + Nudity

Predicts: Mixed or Negative
Actual: Could be all

FURTHER WORK

Data acquisition

Diversity

Big assumption w/dataset: Subjectivity



Multi-class / multi -label

Being able to predict more labels:

Would bring down bias

No image is straightforward



Improve 3-class

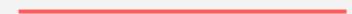
Bring up accuracy



Deployment

Build app

Use for scene production



Cover page photo by [Eryka-Ragna](#) on [Unsplash](#)

Separator pages photo by [Ajeet Mistry](#) on [Unsplash](#)

Full page photo by [Viviana Riske](#) on [Unsplash](#)

Questions? & Appendix

Presentation template by Slidesgo

Icons, infographic & images by Freepik

Research Citation

WikiArt Emotions: An Annotated Dataset of Emotions Evoked by Art

Saif M. Mohammad and Svetlana Kiritchenko (saif.mohammad.svetlana.kiritchenko@nrc-cnc.gc.ca)

RESEARCH QUESTIONS

- what makes art evocative?
- how does art convey different emotions?
- what attributes make a painting well liked?
- how much does the title of an art impact its emotional response?
- what is the extent to which categories of art evoke consistent emotions?

THE SOURCE OF THE ART

WikiArt.org: 151,151 pieces of art; 10 art styles; 168 style categories

- notable art in each category is shown in a *Featured* page
- selected ~200 items from each of the featured pages of 22 categories

Style

Contemporary Art: ~2000 pieces

Minimalism

Modern Art: ~60,000 pieces

Impressionism, Expressionism, Post Impressionism, Surrealism, Abstract Expressionism, Cubism, Pop Art, Abstract Art, Art Informel, Color Field Painting, Neo-Expressionism, Magic Realism, Lyric Abstraction

Post-Renaissance Art: ~ 35,000 pieces

Realism, Romanticism, Baroque, Neoclassicism, Rococo

Renaissance Art: ~6,000 pieces

Northern Renaissance, High Renaissance, Early Renaissance

THE WIKIART EMOTIONS DATASET

www.saifmohammad.com/WebPages/wikiartemotions.html

Annotated 4,105 pieces of art for emotions evoked, amount liked, whether they depict a face

- 10 people per item, crowdsourcing
- 4 styles: Renaissance, Post-Renaissance, Modern, Contemporary
- 22 categories: Impressionism, Figurative art, Realism, etc.

APPLICATIONS

- search paintings evoking the desired emotional response
- automatically detect emotions evoked by paintings
- automatically transform paintings
- identify what makes paintings evocative

LABEL DISTRIBUTION

4 out of 10 say emotion present

AVERAGE ART RATINGS

-3 (dislike a lot) to 3 (like a lot)

Avg. Art Ratings (by emotion)

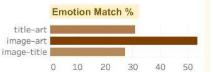


Title: Mona Lisa
Year: 1504
Artist: Leonardo da Vinci
Style: Renaissance
Category: High Renaissance

Annotations:
Avg. art rating: 2.25 Face, body, face
Emotions in image, title: happiness, trust
image: happiness, trust
title: happiness, trust

EMOTIONS EVOKED FROM IMAGE, TITLE, AND ART

- title conveys different sets of emotions than
 - image alone or art as a whole
 - even art and image differ in a large percentage of instances



Title: Don Quixote and Sancho Panza in the mountains, XIX cent.

Artist: Horace Daumier

Style: Impressionism (Modern)

Avg. art rating: 0.4

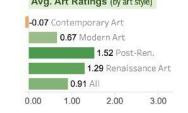
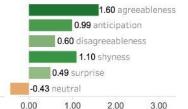
Emotions (image, title): sadness

Emotions (image): fear

Emotions (title): happiness

Other or Mixed

agreement	0.10	15.40
anticipation	0.20	27.40
suspicion	0.10	15.40
vigilance	0.00	0.00
disagreement	0.20	27.40
defiance	0.10	15.40
conflict	0.00	0.00
shyness	0.10	15.40
self-consciousness	0.00	0.00
reserve	0.00	0.00
relief	0.00	0.00
surprise	0.49	1.60
surrealism	0.00	0.00
amazement	0.00	0.00
confusion	0.00	0.00
neutral	0.00	0.00



WHAT MAKES ART WELL LIKED

- art that evokes positive emotions (love, trust, humility, happiness, etc.)
- Post-Renaissance, Renaissance (Realism, Rococo, Neoclassicism, etc.)
- Romanticism, Neoclassicism, Impressionism evoking love as well as Impressionism evoking optimism



Title: Hornet, 1970

Artist: Dan Christensen

Style: Color Field Painting (Modern Art)

Avg. art rating: 0.4

(the most disliked)

Emotions (image, title): anticipation, surprise

Emotions (image): fear

Emotions (title): anticipation



Title: Young mother contemplating her sleeping child in candlelight, 1785

Artist: Albert Anker

Style: Realism (Post Renaissance)

Avg. art rating: 2.8

(the most liked)

Emotions (image, title): happiness, love, trust

Emotions (image): happiness, love

Emotions (title): happiness, love, trust

Canada

WikiArt Emotions

WikiArt Emotions: An Annotated Dataset of Emotions Evoked by Art

Saif M. Mohammad and Svetlana Kiritchenko.

In Proceedings of the 11th Edition of the Language Resources and Evaluation Conference (LREC-2018), May 2018, Miyazaki, Japan.

Dataset DataFrame

Presence/ Absence of Emotion

In [9]: emotions_df_5.head(3)

Out[9]:

Style	Category	Artist	Title	Year	Is painting	Face/body	Ave. art rating	Art (image+title): agreeableness	...	TitleOnly: love	TitleOnly: optimism	TitleOnly: pessimism	TitleOnly: regret	TitleOnly: sadness	TitleC sh:
Modern Art	Impressionism	Charles Courtney Curran	In the Luxembourg Garden	1889	yes	face	2.33	0 ...	0	0	0	0	0	0	0
Modern Art	Neo-Expressionism	Keith Haring	The Marriage of Heaven and Hell	1984	yes	body	0.70	0 ...	0	0	0	0	0	0	0
Modern Art	Post-Impressionism	Jozsef Rippl-Ronai	Uncle Piacsek in front of the Black Sideboard	1906	yes	face	1.60	0 ...	0	0	0	0	0	0	0

WikiArt Emotions

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In Proceedings of the 11th Edition of the Language Resources and Evaluation Conference (LREC-2018), May 2018, Miyazaki, Japan.

Dataset DataFrame Probability of Emotion

In [29]: prob_df.head(3)																
Out[29]:																
ID	Style	Category	Artist	Title	Year	Is painting	Face/body	Ave. art rating	Art (image+title): agreeableness	...	TitleOnly: love	TitleOnly: optimism	TitleOnly: pessimism	TitleOnly: regret	TitleOnly: sadness	T
3e1ae	Modern Art	Impressionism	Charles Courtney Curran	In the Luxembourg Garden	1889	yes	face	2.33	0.036	...	0.155	0.238	0.024	0.012	0.024	0.024
3e76	Modern Art	Neo-Expressionism	Keith Haring	The Marriage of Heaven and Hell	1984	yes	body	0.70	0.000	...	0.200	0.000	0.100	0.000	0.000	0.000
5fa9	Modern Art	Post-Impressionism	Jozsef Rippl-Ronai	Uncle Piacsek in front of the Black Sideboard	1906	yes	face	1.60	0.000	...	0.000	0.000	0.000	0.000	0.000	0.000

WikiArt Emotions

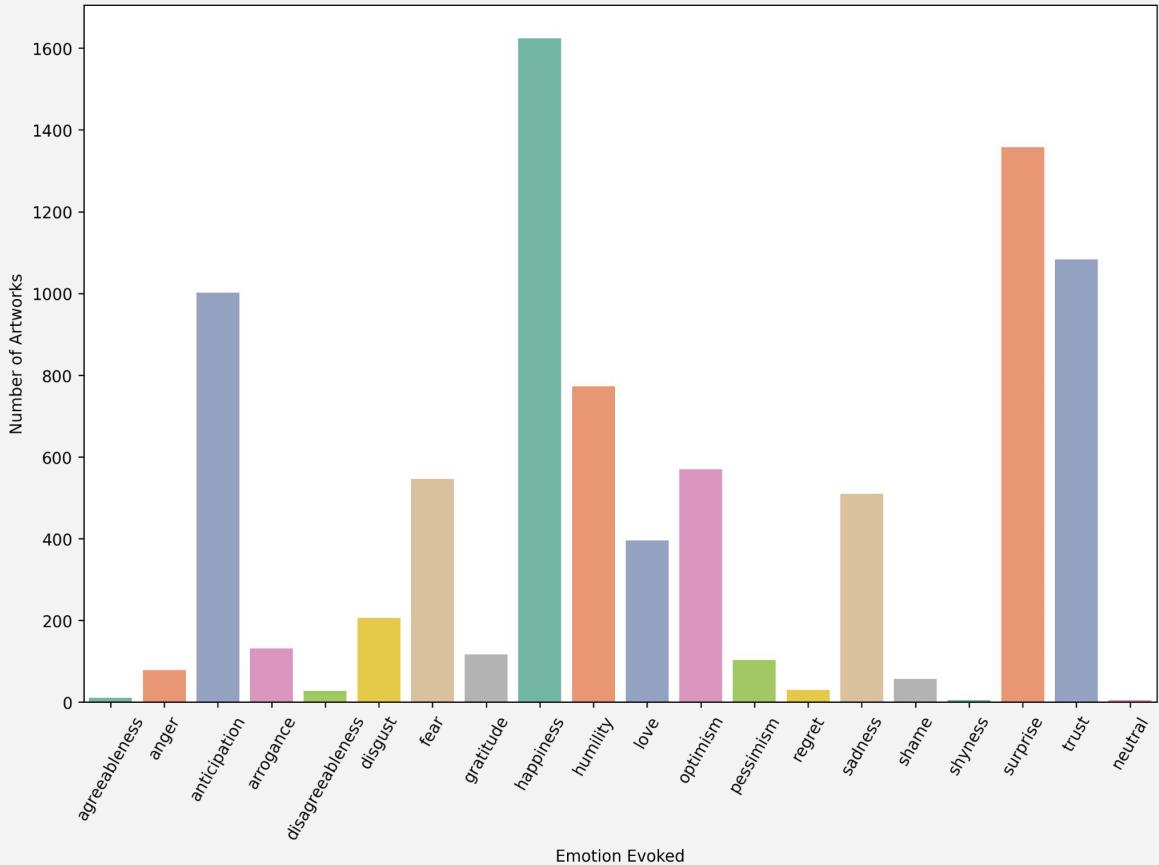
WikiArt Emotions: An Annotated Dataset of Emotions Evoked by Art.

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In Proceedings of the 11th Edition of the Language Resources and Evaluation Conference (LREC-2018), May 2018, Miyazaki, Japan.

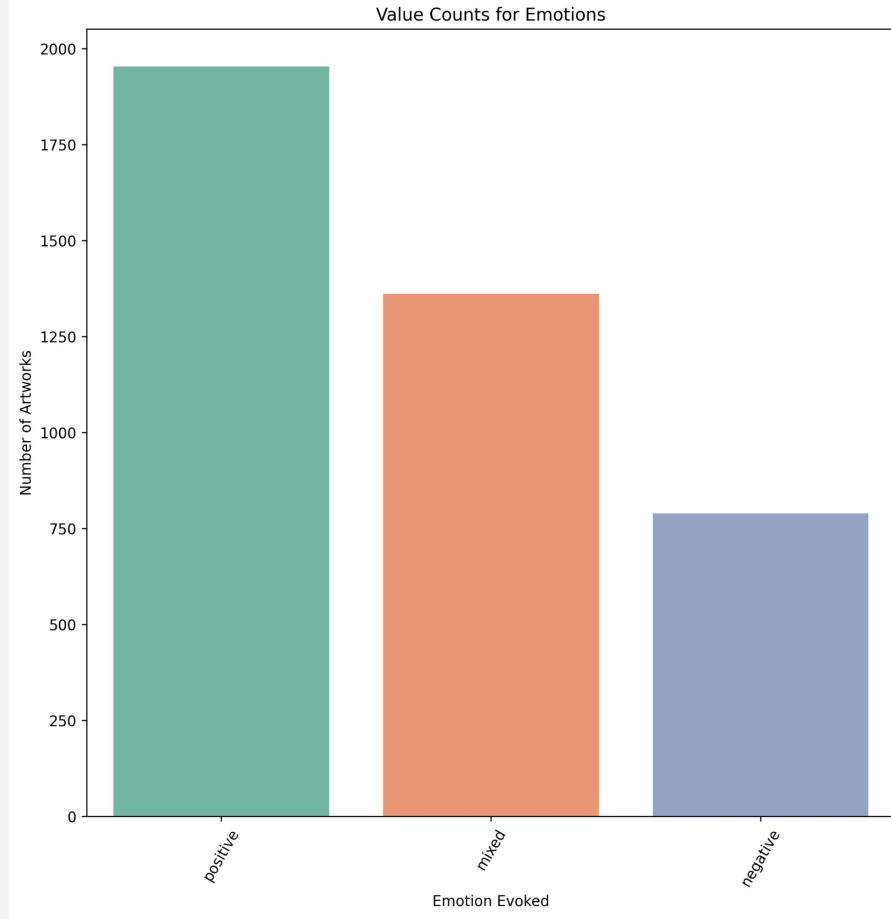
TARGET Distribution

All Emotions Evoked



TARGET Distribution

Top Emotion Evoked (3-class)



MODEL Architecture Beginning

```
▶ model_tc_mobilenet_aug = Model(inputs=base_model.input, outputs=predictions)
model_tc_mobilenet_aug.compile(optimizer='adam', loss='categorical_crossentropy', metrics=['accuracy'])
model_tc_mobilenet_aug.summary()
```

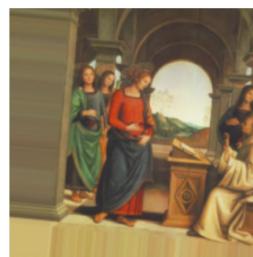
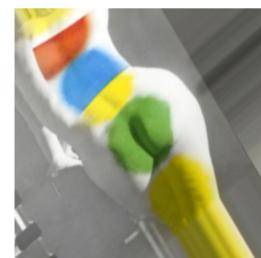
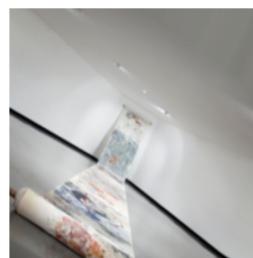
Layer	Type	Shape	Weights	Operations
block_1_project	Conv2D	(None, 56, 56, 24)	2304	['block_1_depthwise_relu[0][0]']
block_1_project_BN	BatchNormal	(None, 56, 56, 24)	96	['block_1_project[0][0]']
block_2_expand	Conv2D	(None, 56, 56, 144)	3456	['block_1_project_BN[0][0]']
block_2_expand_BN	BatchNormal	(None, 56, 56, 144)	576	['block_2_expand[0][0]']
block_2_expand_relu	ReLU	(None, 56, 56, 144)	0	['block_2_expand_BN[0][0]']
block_2_depthwise	DepthwiseCo	(None, 56, 56, 144)	1296	['block_2_expand_relu[0][0]']
block_2_depthwise_BN	BatchNor	(None, 56, 56, 144)	576	['block_2_depthwise[0][0]']
block_2_depthwise_relu	ReLU	(None, 56, 56, 144)	0	['block_2_depthwise_BN[0][0]']
block_2_project	Conv2D	(None, 56, 56, 24)	3456	['block_2_depthwise_relu[0][0]']
block_2_project_BN	BatchNorma	(None, 56, 56, 24)	96	['block_2_project[0][0]']
block_2_add	Add	(None, 56, 56, 24)	0	['block_1_project_BN[0][0]', 'block_2_project_BN[0][0]']
block_3_expand	Conv2D	(None, 56, 56, 144)	3456	['block_2_add[0][0]']
block_3_expand_BN	BatchNormal	(None, 56, 56, 144)	576	['block_3_expand[0][0]']
block_3_expand_relu	ReLU	(None, 56, 56, 144)	0	['block_3_expand_BN[0][0]']
block_3_pad	ZeroPadding2D	(None, 57, 57, 144)	0	['block_3_expand_relu[0][0]']
block_3_depthwise	DepthwiseCo	(None, 28, 28, 144)	1296	['block_3_pad[0][0]']
block_3_depthwise_BN	BatchNor	(None, 28, 28, 144)	576	['block_3_depthwise[0][0]']
block_3_depthwise_relu	ReLU	(None, 28, 28, 144)	0	['block_3_depthwise_BN[0][0]']
block_3_project	Conv2D	(None, 28, 28, 32)	4608	['block_3_depthwise_relu[0][0]']
block_3_project_BN	BatchNorma	(None, 28, 28, 32)	128	['block_3_project[0][0]']
block_4_expand	Conv2D	(None, 28, 28, 192)	6144	['block_3_project_BN[0][0]']

MODEL Architecture End

block_15_expand_relu (ReLU)	(None, 7, 7, 960)	0	['block_15_expand_BN[0][0]']
block_15_depthwise (DepthwiseC)	(None, 7, 7, 960) onv2D)	8640	['block_15_expand_relu[0][0]']
block_15_depthwise_BN (BatchNo rmalization)	(None, 7, 7, 960)	3840	['block_15_depthwise[0][0]']
block_15_depthwise_relu (ReLU)	(None, 7, 7, 960)	0	['block_15_depthwise_BN[0][0]']
block_15_project (Conv2D)	(None, 7, 7, 160)	153600	['block_15_depthwise_relu[0][0]']
block_15_project_BN (BatchNorm alization)	(None, 7, 7, 160)	640	['block_15_project[0][0]']
block_15_add (Add)	(None, 7, 7, 160)	0	['block_14_add[0][0]', 'block_15_project_BN[0][0]']
block_16_expand (Conv2D)	(None, 7, 7, 960)	153600	['block_15_add[0][0]']
block_16_expand_BN (BatchNorma lization)	(None, 7, 7, 960)	3840	['block_16_expand[0][0]']
block_16_expand_relu (ReLU)	(None, 7, 7, 960)	0	['block_16_expand_BN[0][0]']
block_16_depthwise (DepthwiseC onv2D)	(None, 7, 7, 960)	8640	['block_16_expand_relu[0][0]']
block_16_depthwise_BN (BatchNo rmalization)	(None, 7, 7, 960)	3840	['block_16_depthwise[0][0]']
block_16_depthwise_relu (ReLU)	(None, 7, 7, 960)	0	['block_16_depthwise_BN[0][0]']
block_16_project (Conv2D)	(None, 7, 7, 320)	307200	['block_16_depthwise_relu[0][0]']
block_16_project_BN (BatchNorm alization)	(None, 7, 7, 320)	1280	['block_16_project[0][0]']
Conv_1 (Conv2D)	(None, 7, 7, 1280)	409600	['block_16_project_BN[0][0]']
Conv_1_bn (BatchNormalization)	(None, 7, 7, 1280)	5120	['Conv_1[0][0]']
out_relu (ReLU)	(None, 7, 7, 1280)	0	['Conv_1_bn[0][0]']
flatten_1 (Flatten)	(None, 62720)	0	['out_relu[0][0]']
dense_3 (Dense)	(None, 512)	32113152	['flatten_1[0][0]']
dense_4 (Dense)	(None, 50)	25650	['dense_3[0][0]']
dense_5 (Dense)	(None, 3)	153	['dense_4[0][0]']
=====			
Total params: 34,396,939			
Trainable params: 32,138,955			
Non-trainable params: 2,257,984			

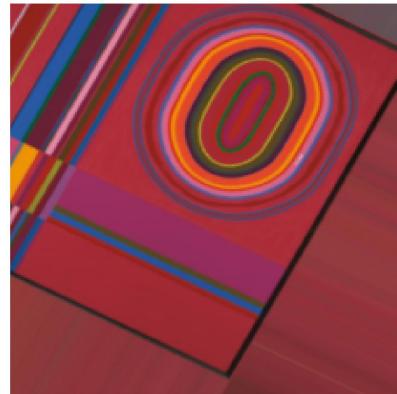
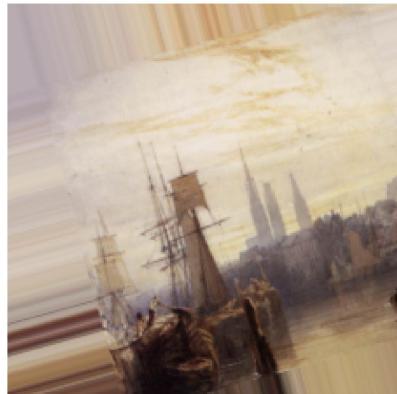
IMAGES

Distortion (3 - class)

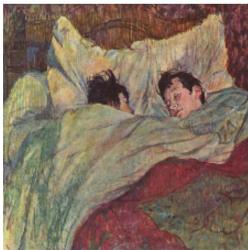
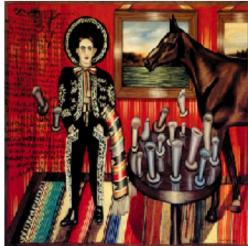


IMAGES

Distortion (3 - class)



Predicted: Negative. Actual: Positive



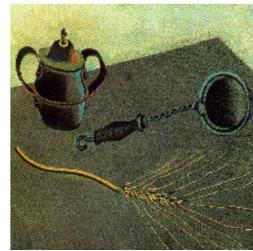
Predict **Negative**
Actual **Positive**

Predicted: Negative. Actual: Mixed



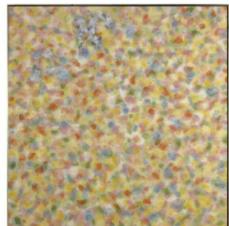
**Predict Negative
Actual Mixed**

Predicted: Mixed. Actual: Positive



Predict **Mixed**
Actual **Positive**

Predicted: Mixed. Actual: Negative



Predict **Mixed**
Actual **Negative**