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SRM: Tech Visionaries

- Harikrishnan S | 2022 | SRM IST, KTR
- P Jemuel Stanley | 2022 | SRM IST, KTR
- K V Venkata Sanjay | 2022 | SRM IST, KTR
- Gautham Ganesh Prasad | 2022 | SRM IST, KTR
- Bharadwaj A P | 2022 | SRM IST, KTR

CONTACT DETAILS:

Harikrishnan S

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ABOUT US

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Name	Notable Work and Experience
Harikrishnan S	• Worked in an AI project regarding real time monitoring of person's working with CNN implemented using the architecture of Mobile Net SSD • Article on ANN - https://link.medium.com/dOtZw6R1Gcb • Blink counter – Using facial landmarks and contour based approach • Specialization in Robotics and Computer Vision
Gautham Ganesh Prasad	• Trained a pre-built CNN for real time Object Detection and identification. • Worked on Computer Vision Application of Mapping using Aerial-Bot(Drones) • Worked on Computer Vision Application of Mapping using Mobile Robot.
P Jemuel Stanley	• Built CNN and applied Semantic Segmentation for Drivable Surface Estimation for Self-Driving Cars. • Vehicle Trajectory Estimation from features extracted from consecutive camera images. • Stereo Visual Odometry • Blister Pack Inspection

Name	Notable Work and Experience
K V Venkata Sanjay	• Blister Pack Inspection • Trained a CNN for real time Object Detection and identification. • Apple localization and tracking
Bharadwaj AP	• Object detection with OpenCV and Python • Image Classification with CNN using Keras

Name	HACKATHON
Harikrishnan S	• SMART India Hackathon • Maverick 2.0 • OpenCV AI Competition 2021
Bharadwaj AP	• Maverick 2.0
Gautham and Jemuel Stanley	• OpenCV AI Competition 2021

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PROBLEM: FACE DETECTION ALGORITHM

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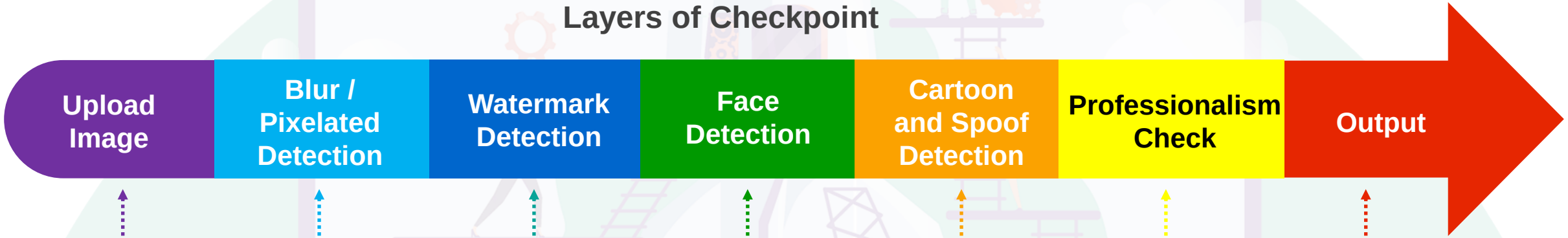
PROCESS FLOW

Layers of Checkpoint



Django

Store the image file in local directory

Frequency and Spatial Analysis

Preset threshold determines Blur/Pixelated levels

CNN

Custom CNN architecture for binary classification

ResNet

- Facial landmarks detection
- Faces count

Histogram based thresholding & Extra Tree Classifier

CNN

- Pose
- Emotion
- Background

Approval

Message: Image Accepted or Rejected

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UNIQUE SELLING POINT

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All-in-one Solution

Obstruction Detection

Identify obstructions on face area

Blur and Pixelation Detection

Identify if photo if face region is blurred

Face Detection

Identify number of people present in photo
Thumbnail generation

Identify Watermarks

Identify watermarked or stamped images

Professionalism Check

Pose of the person, Clothing, Expression, Background, Lighting

Spoof Detection

Identify if input picture is a photo of a printed photo

Tech Stack

Please mention your Tech Stack (wherever applicable)

- Backend framework - Django, Python
- Frontend framework – Django, TensorFlow, Caffe Model, Keras, OpenCV
- Cloud Service Providers - None
- Datasets – CIFAR, KAGGLE, ICML_FACEDATA, IMAGENET, fer 2013

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DJANGO

- Django is a python-based framework used for web API development, for making its frontend and backend.
- We are using this framework because of its simplicity and scope of upgrading with better features.
- The user/client uploads the Image to be tested for the stated requirements through a given URL.
- The Input image is then stored into the Server side enabling access to the code for testing each requirement.
- The Output/ Result from the code is sent back to the Client side(URL).

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BLUR AND PIXELATION DETECTION

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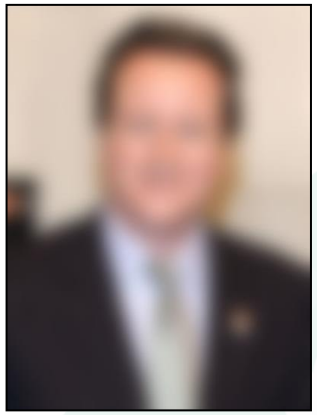
DIFFERENT CASES OF BLUR

Full Blur



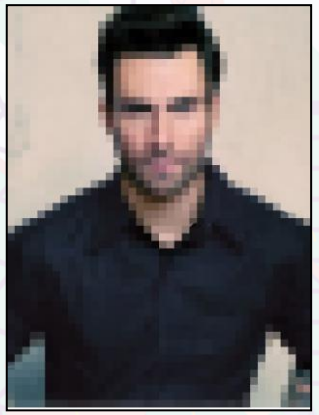
Motion Blur

Face Blur

Clothing Blur

Lens Blur

Face Pixelated



Full Pixelated

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PROPOSED SOLUTION

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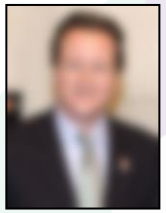
Laplace

Pixelated detection

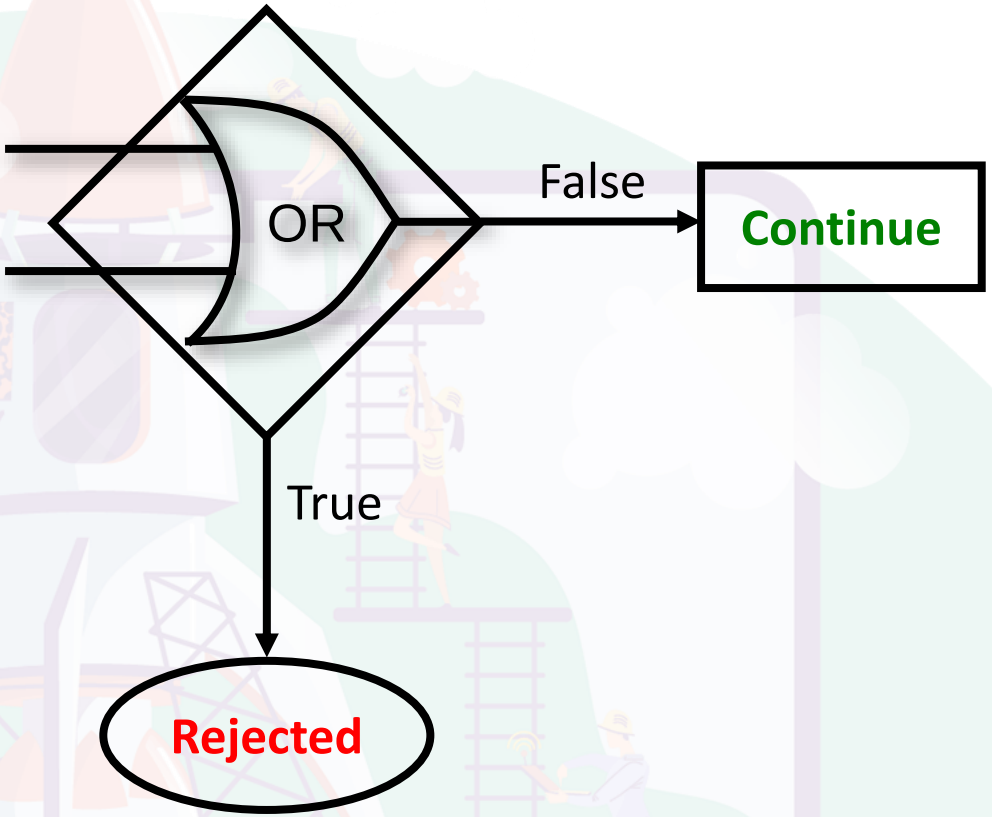
$$= \begin{cases} Accepted, \sigma^2 < thresh \\ Pixelated, \sigma^2 \geq thresh \end{cases}$$

FFT



Blur detection

$$= \begin{cases} Blurred, \mu < thresh \\ Accepted, \mu \geq thresh \end{cases}$$



$\mu \rightarrow Mean$

$\sigma^2 \rightarrow Variance$

$FFT \rightarrow Fast\ Fourier\ Transform$

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WATERMARK DETECTION

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DIFFERENT CASES OF WATERMARKS

Orientation

Edge

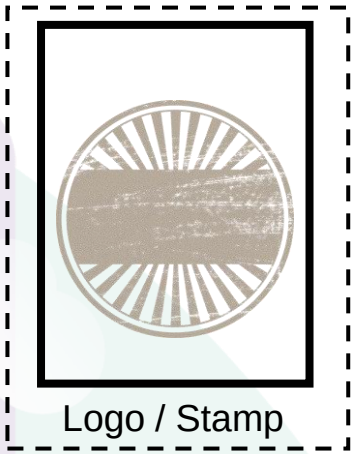
Across

MULTIPLE

Multiple Text

Multiple logo/stamp

TYPE



Logo / Stamp

Text

For future prospect

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PROPOSED SOLUTION

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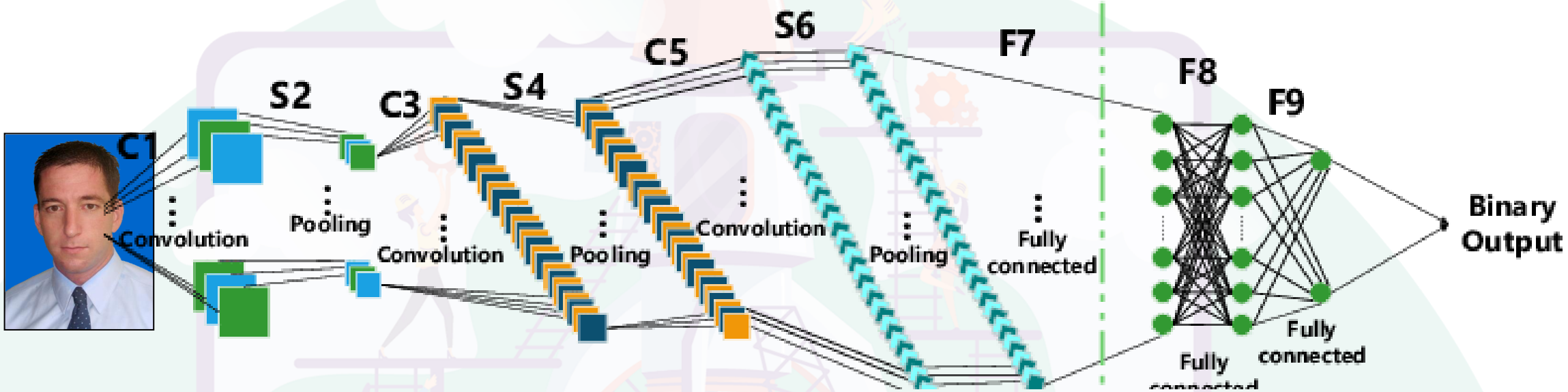

Custom CNN architecture for binary classification with "ELU" activation function for convolution layer 1,3 and 5 and sigmoid activation function for layer 9

Dataset to be used: An open-source data set from Kaggle made publicly available containing watermarked and non-watermarked image of varying size.

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FACE DETECTION AND COUNT

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DIFFERENT CASES OF FACE DETECTION AND COUNT

Single face

Multiple faces

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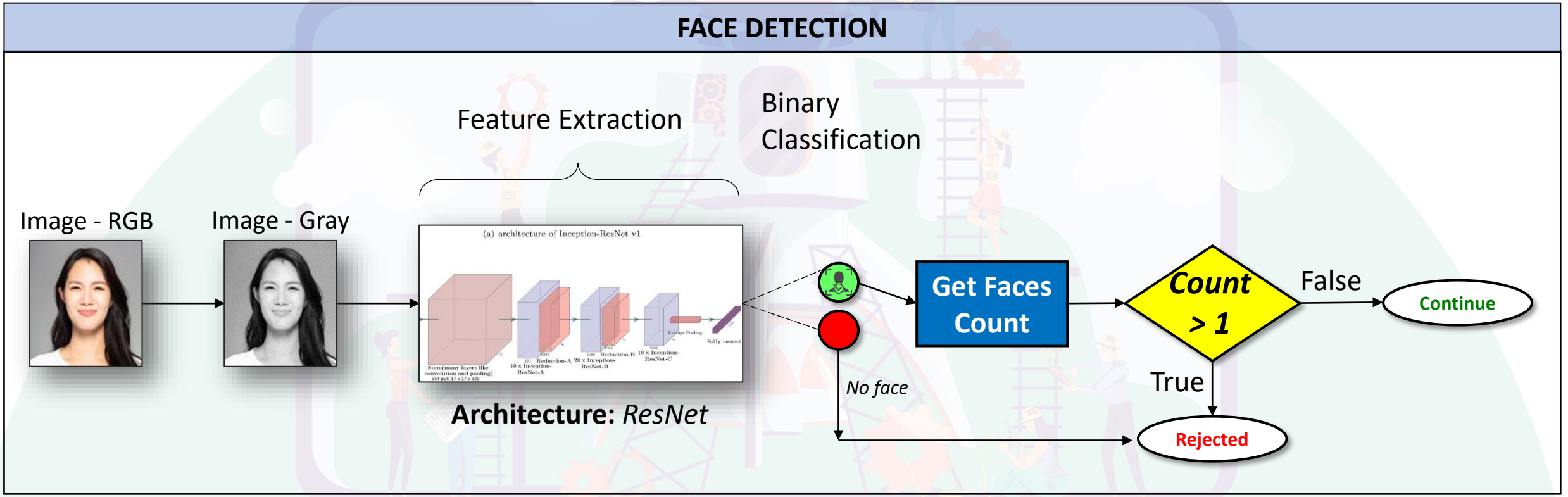
PROPOSED SOLUTION – FACE DETECTION AND COUNTING



Dataset to be used: *fer 2013* – An open source data set made publicly available containing 48 X 48 pixel grayscale images of faces.

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Real, Cartoon/Avatar differentiation

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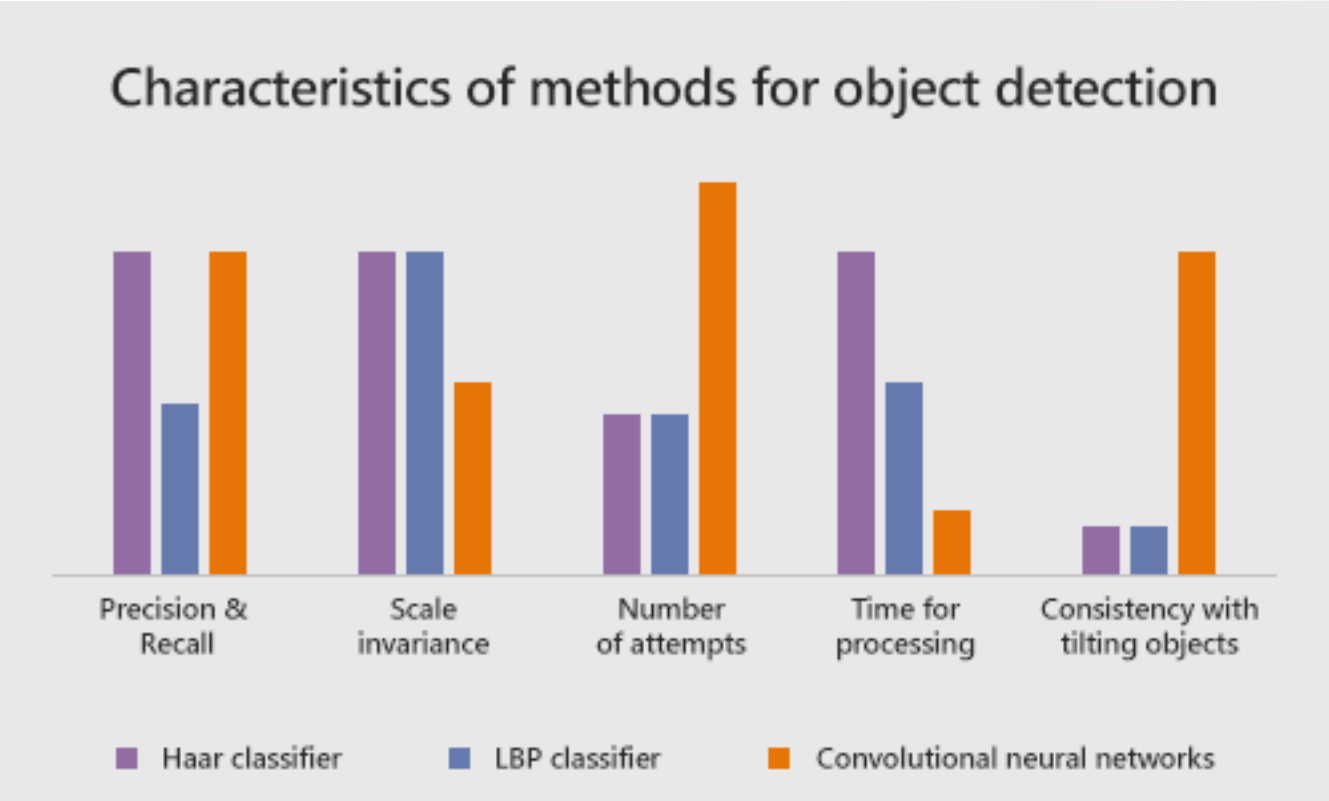
WHY ResNet OVER HAAR CLASSIFIER



- High possibility in Haar cascades not recognizing the face in different angles.
- We can even check to filter out weak detections/recognitions of face using ResNet simply by getting the confidence value of the model.
- Time required for processing (refer the figure on left) is very less for the CNN(Caffe Model) compared to the Haar cascades.

Note: ResNet performs better

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SAMPLE OUTPUT

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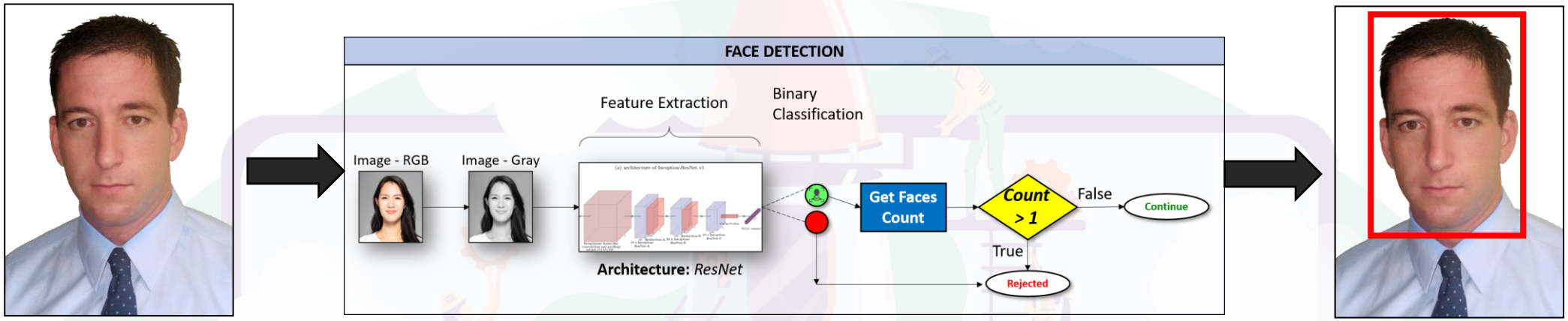
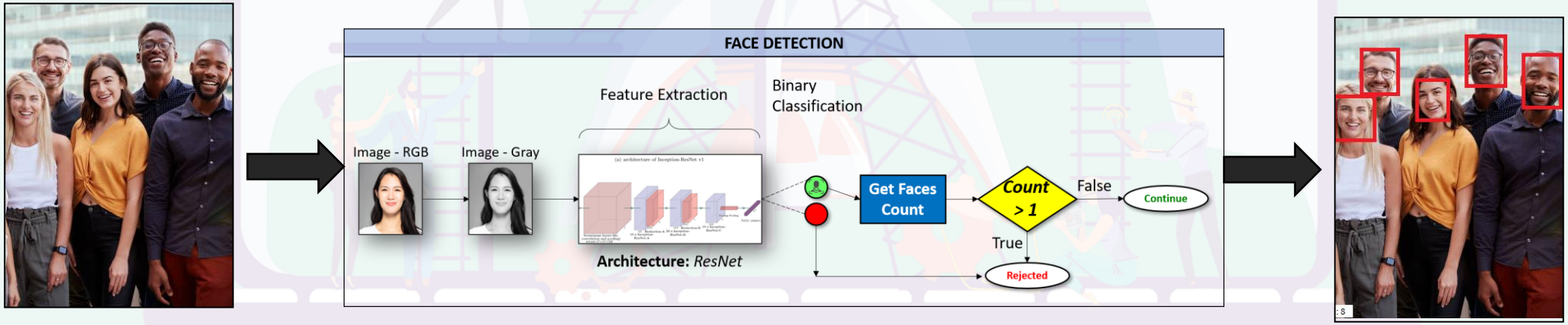
CASE-1 : Single face



CASE-2: Multiple faces



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OBSTRUCTION DETECTION

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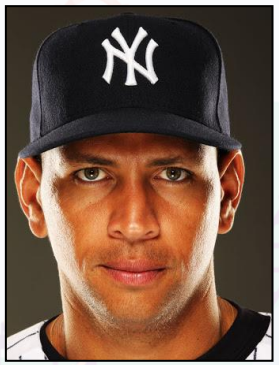
DIFFERENT CASES OF FACIAL OBSTRUCTIONS

ACCESSORIES

Mask

Sunglasses



Cap

HAND OBSTRUCTION

Hand on side

Fully Covered

Partially

Note: All facial landmarks still detectable

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PROPOSED SOLUTION

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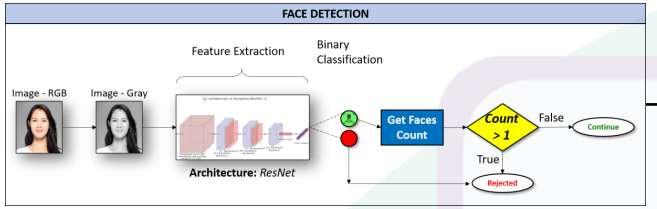
OBSTRUCTION DETECTION



Get Facial Landmarks

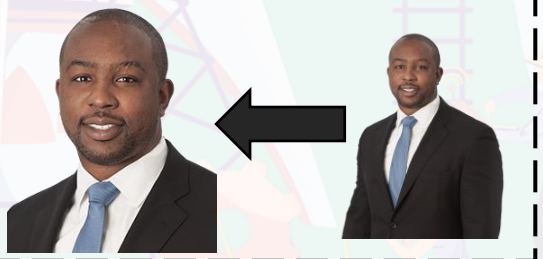
All landmarks detected?

False

Rejected

True

Continue



Centralize the face based on landmarks

POSE ESTIMATION

Continue

THUMBNAIL GENERATION

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Real, Cartoon/Avatar differentiation

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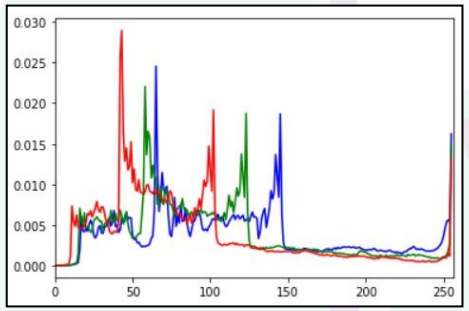
DIFFERENT CASES OF

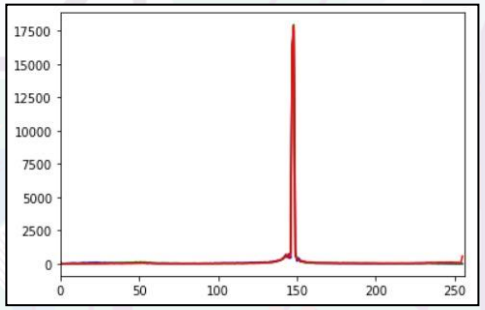
Real

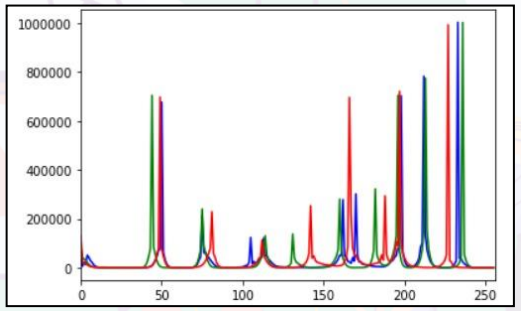
Cartoon

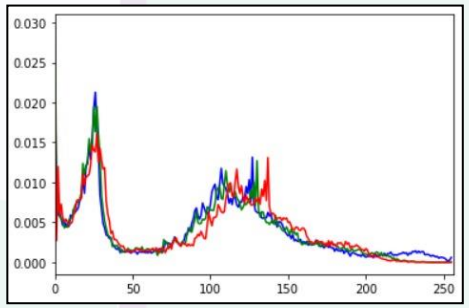
Cartoonized real

Real looking Cartoon









Note: All cartoon images have low quantization levels of colour.

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PROPOSED SOLUTION

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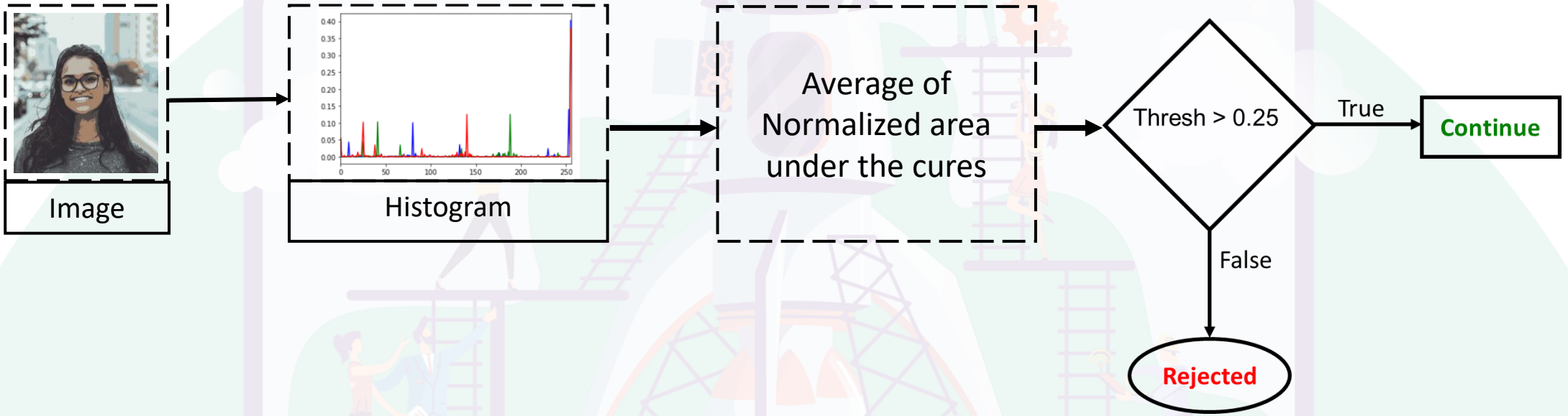

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Explanation

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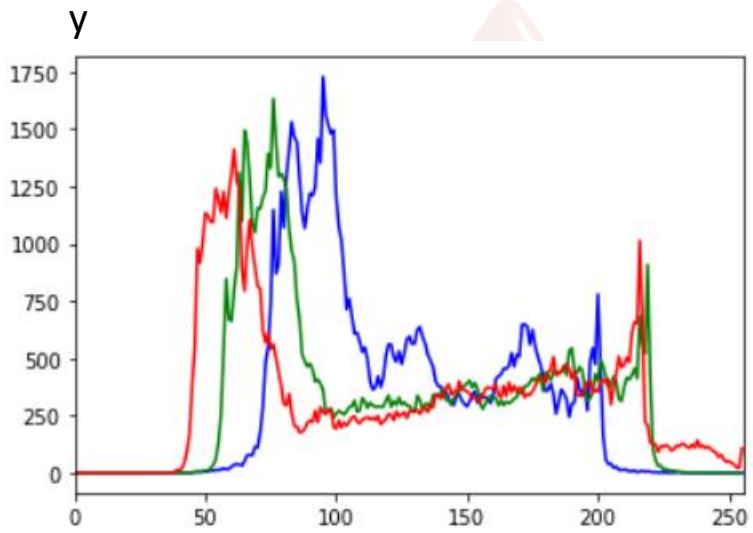
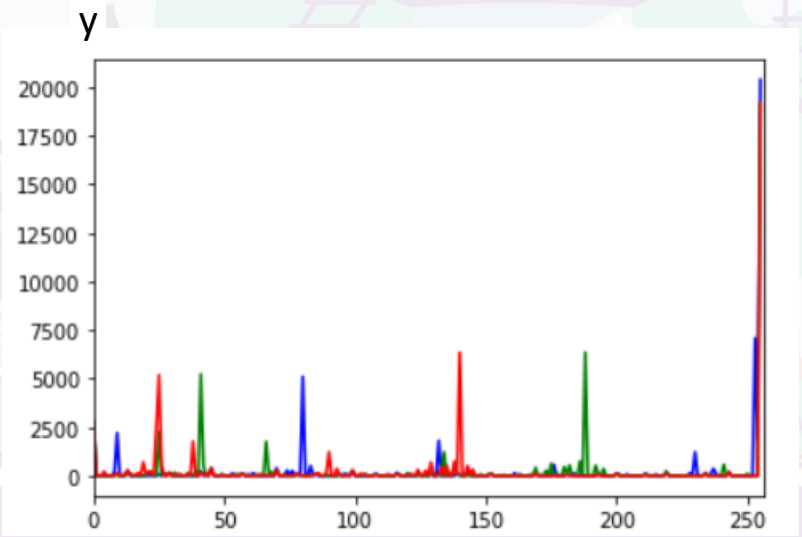
Case 1: Real image



Pixels values are more continuous and cover wide range of values so less impulses in histogram. Hence the average of area under the curves is experimentally found to be more then 25% of highest possible area (y_{max} * 255).

Case 2: Cartoon



Pixels values are less continuous and quantized so more impulses in histogram. Hence the average of area under the curves is experimentally found to be less then 25% of highest possible area (y_{max} * 255).

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SPOOF DETECTION

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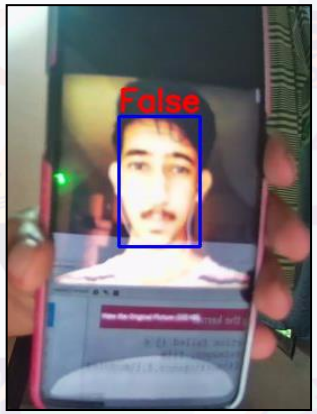
DIFFERENT CASES OF SPOOF

Part of screen



Taken from photo

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PROPOSED SOLUTION

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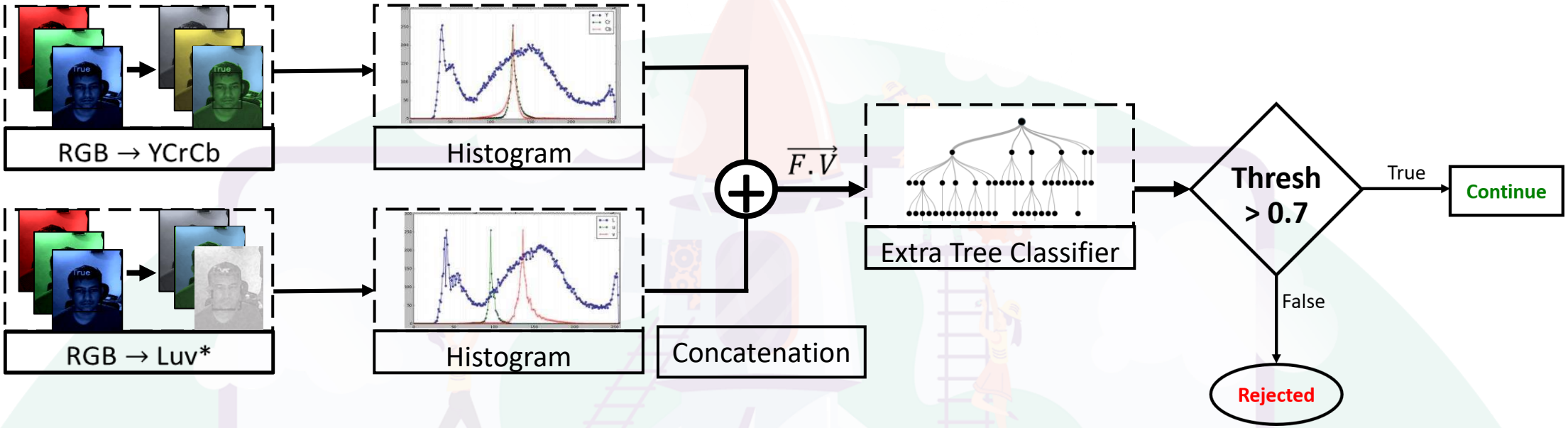

$$\overrightarrow{F.V} \rightarrow Feature\ Vector = \{Y, Cr, Cb, L, u, v\}$$

Note: Normal RGB color space is not used because the correlation between the R,G,B channels obstructs separation between luminance and chrominance which is essential to detect spoofs

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SAMPLE OUTPUT

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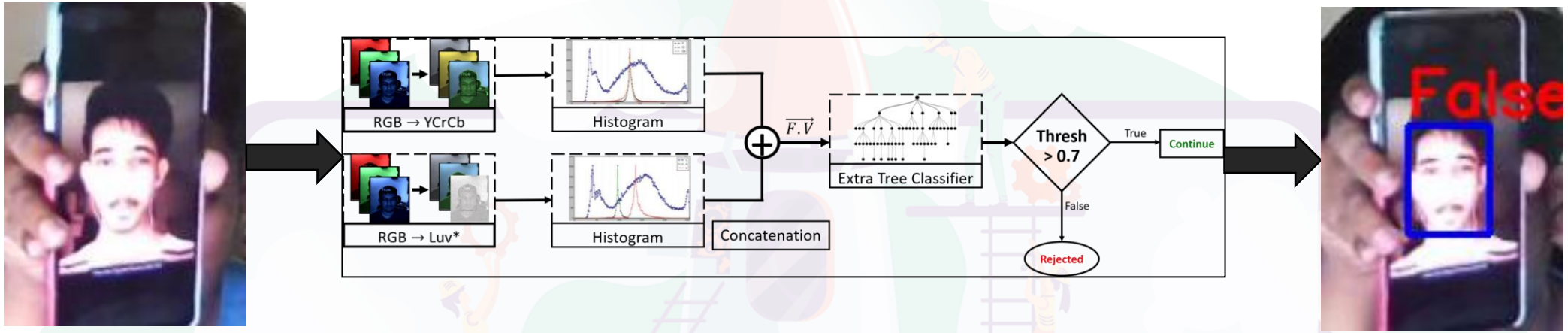
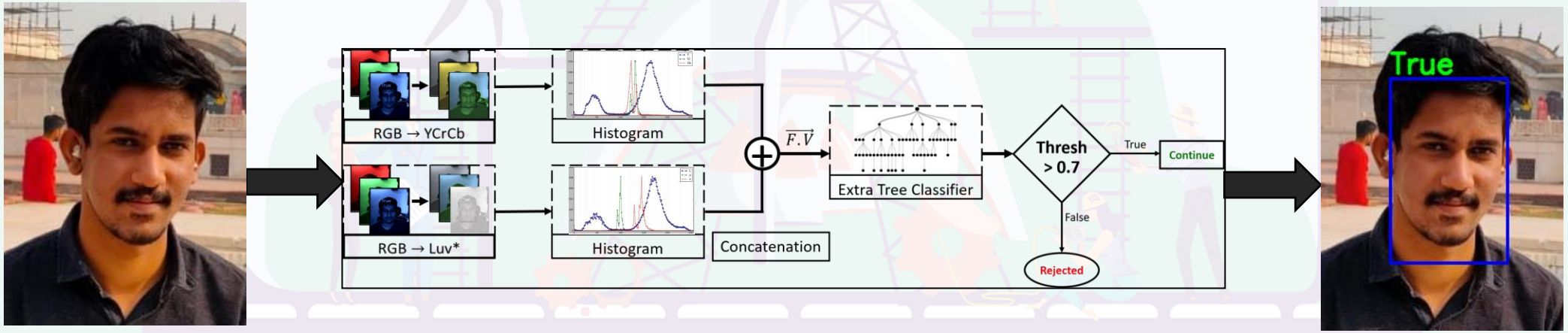
CASE-1: Part of Screen



CORRECT : Original Photo



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PROFESSIONALISM DETECTION

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DIFFERENT CASES OF UNPROFESSIONAL PHOTOS

POSE

Face orientation

Hands visibility

EXPRESSION

BACKGROUND

Gradient Background

Outdoors

LIGHTING

Uneven Lighting

Coloured gel

CLOTHING

Casual dress

Party Wear

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POSE ESTIMATION

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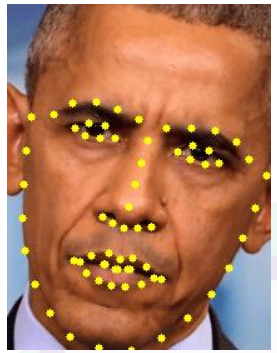
Thumbnail Generation



Facial Landmark Detection

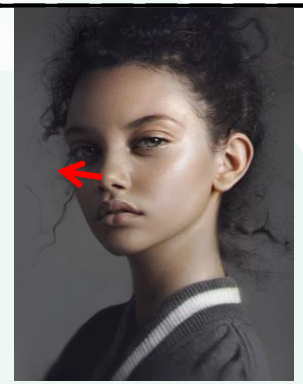
Estimate f based on geometry

Estimate $R$and t matrices

Geometric Camera Calibration

Estimate coordinates of Facial Landmarks in 3D

PnP using RANSAC model and Project Nose tip point



Set thresholds for α, β, γ

$T_\alpha, T_\beta, T_\gamma < Thresh$

True

Continue

False

Rejected

$R \rightarrow Rotation\ Matrix$

$t \rightarrow Translation\ Matrix$

$f \rightarrow Focal\ Length$

$PnP \rightarrow Perspective - and - Point$

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SAMPLE OUTPUT– POSE

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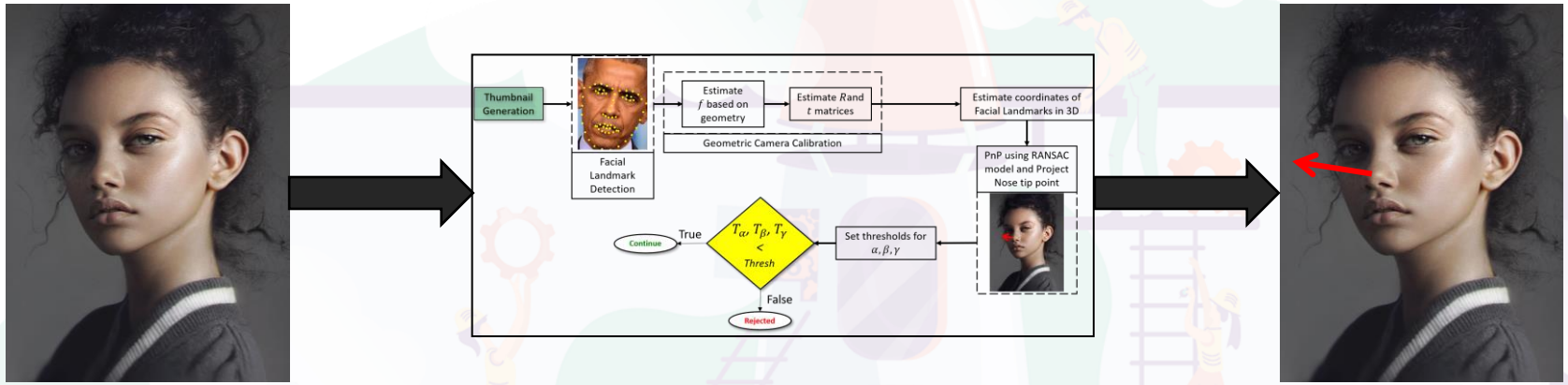
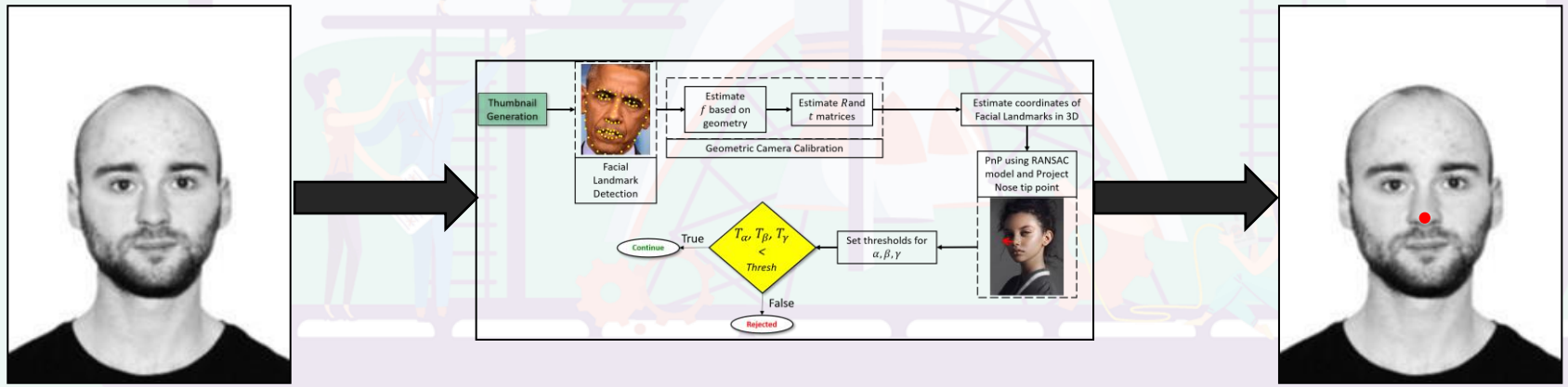
CASE-1: Side pose



CORRECT : Towards screen



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PROPOSED SOLUTION - EMOTION

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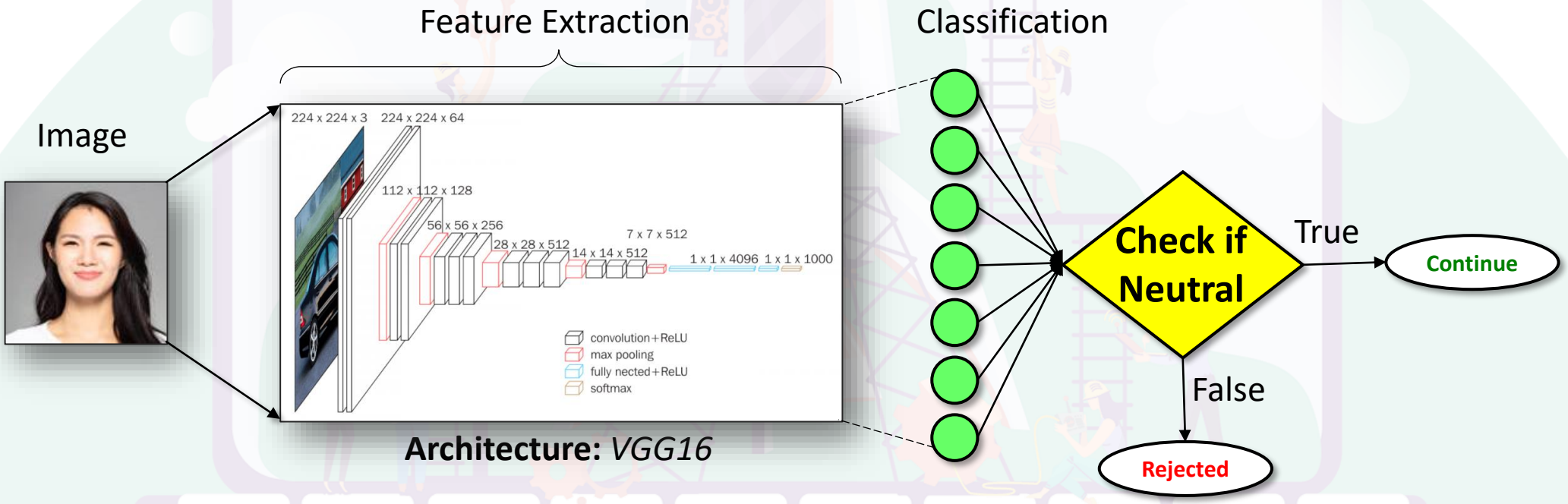
Happy | Surprised | Disgust | Neutral | Fear | Sad | Angry



Architecture: *VGG16*

Dataset to be used: *fer 2013* – An open source data set made publicly available containing 48 X 48 pixel grayscale images of faces.

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SAMPLE OUTPUT

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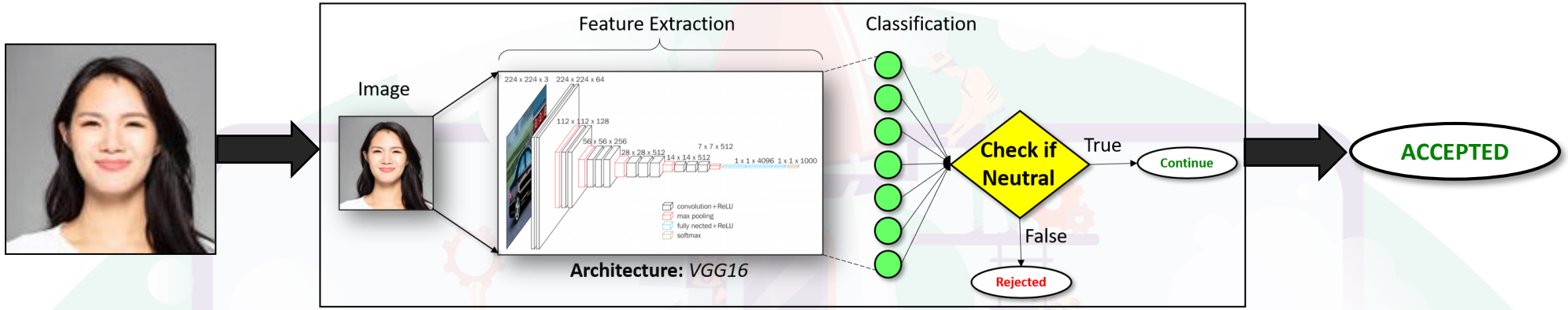
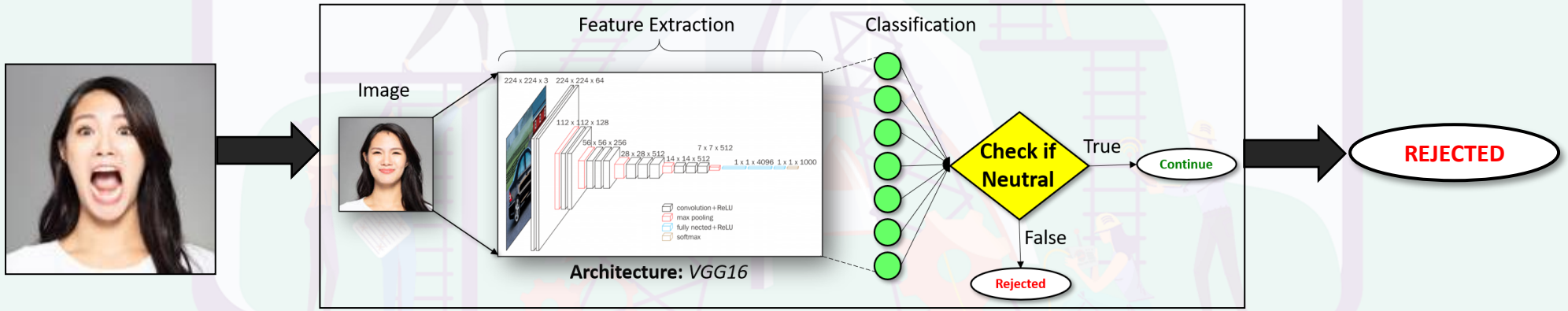
CORRECT : Neutral



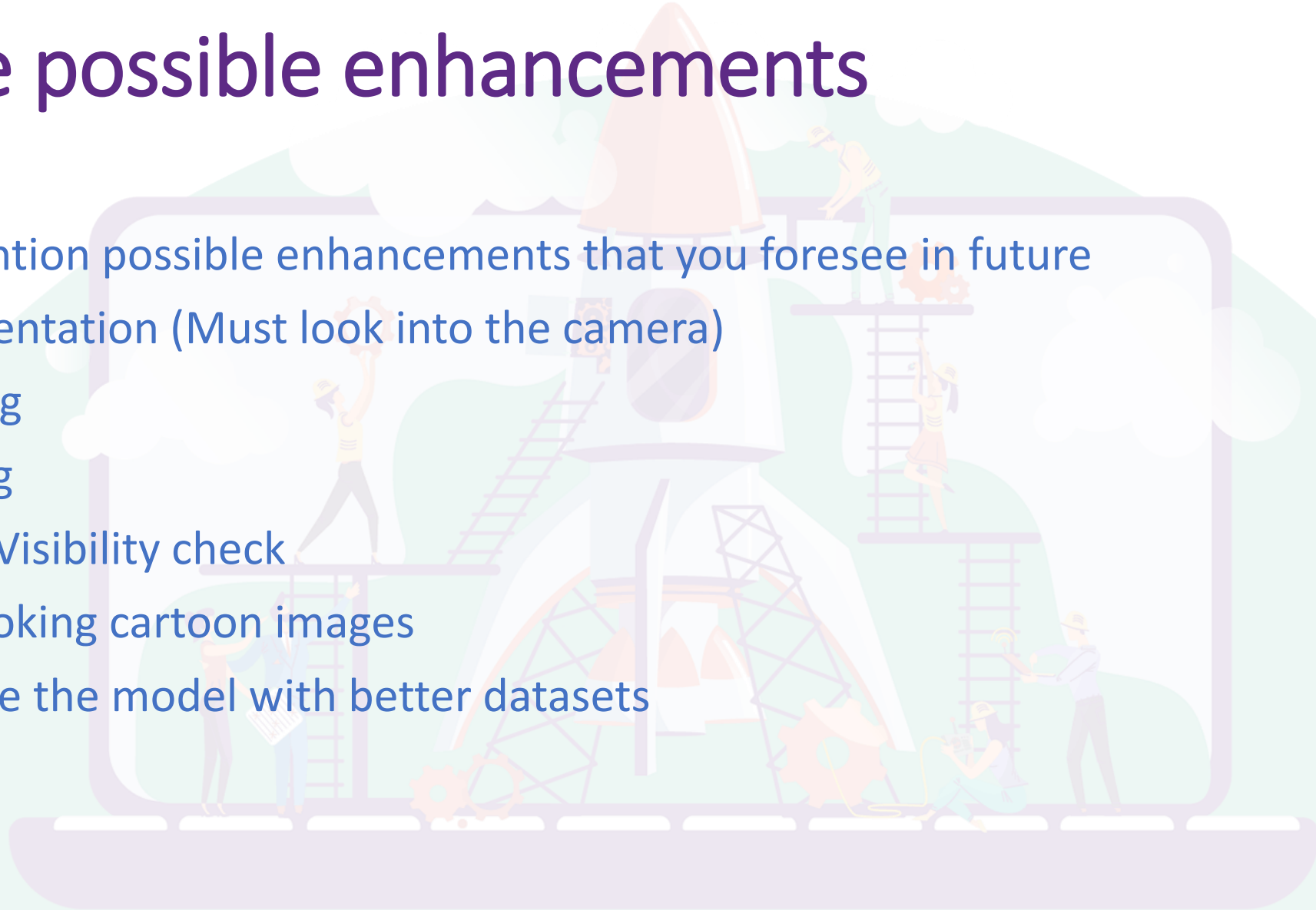
CASE-2 : Surprised



Future possible enhancements

Please mention possible enhancements that you foresee in future

1) Eye orientation (Must look into the camera)
2) Clothing
3) Lighting
4) Hands Visibility check
5) Real looking cartoon images
6) Improve the model with better datasets



Risks/ Challenges / Dependencies

- Cases mentioned under future prospects presently won’t be addressed and are challenging

Anything Else ?

- Better performance can be achieved if appropriate datasets (Relevant to medical background) are provided