Final Year Project
Digital Makeup

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Project No. : SCSE23-0343

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Introduction

Background

Social Media has become popular

People taking selfies to share their happy moment

Google Photos reported a staggering 24 billion selfies in year 2015 [1]

What is the problem?

Extra Effort

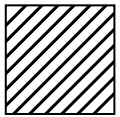
Need to edit photo before sharing it to social media

Time Consuming

Quality editing is time consuming

Automate Process for Editing Photos

Automate the photo editing process:
Digital Makeup



Objective and Scope

Learn about the state-of-the-art machine learning algorithm in current technology, which can significantly reduce the time/efforts of people in the modern world to polish facial images

Goals

1. Perform semantic segmentation using a pre-trained Fully Convolutional Neural Network(CNN) model [6] which is used to recognize the facial features of a person.

2. Succeed in transferring the color of significant facial features from a person in the reference image to the target image.

02

Literature Review

Color Transfer Between Images

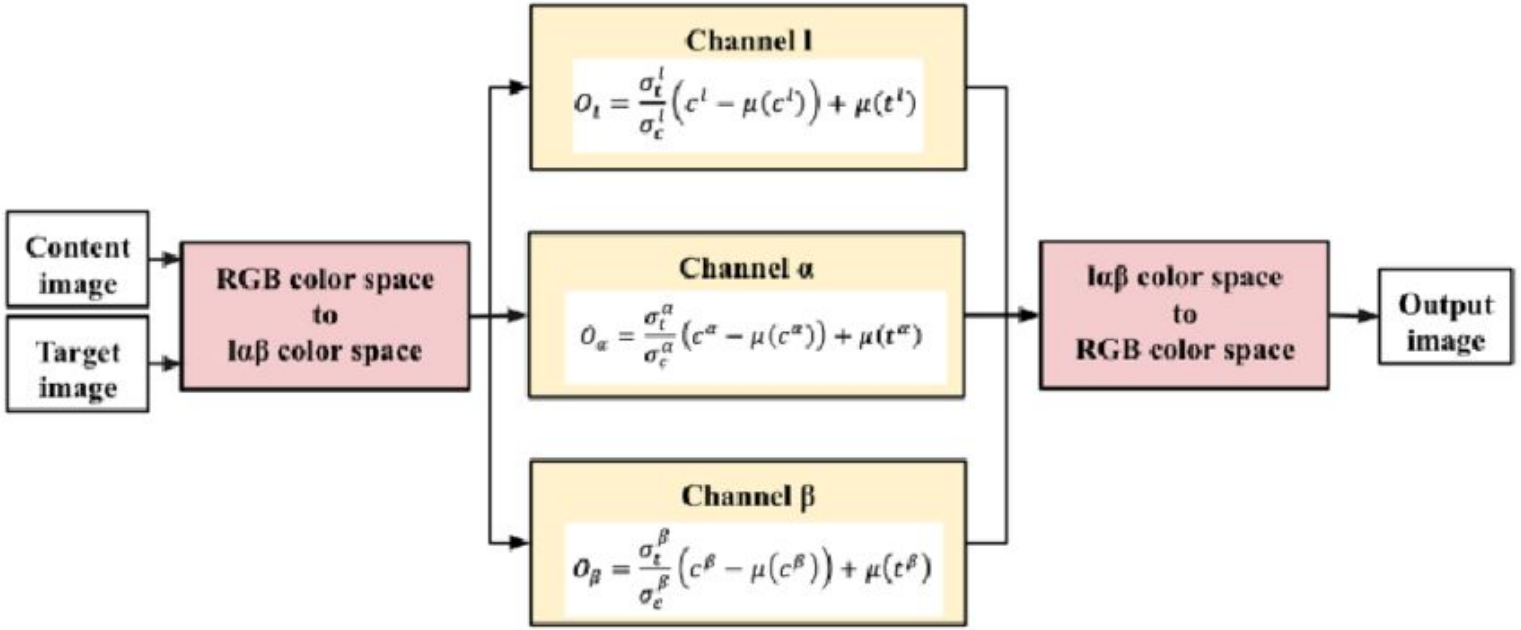
What is Color Transfer ?

- A function that transforms the color of one image(source) to the color of another image(target).
- Manual Editing is Time Consuming -> Color Transfer Algorithm is useful.
- Numerous researchers have conducted experiments to transfer color between images.

Reinhard Color Transfer

- Reinhard et al has proposed a simple yet effective automatic color transfer algorithm
- ℓαβ color space developed by Ruderman et al. minimizes the correlation between channels for many natural scenes.
- First converts RGB to ℓαβ color space, then adjusts and scales each pixel value of the source image based on a linear equation to match the mean and standard deviation of the target image and finally, the target image is converted back to RGB color space

Reinhard Color Transfer



Example: Reinhard Color Transfer

Destination Image

Source Image

Result Image

Takeaways: Reinhard Color Transfer

- Color Transfer Between Images Algorithm
- Importance of Color Space Choice when performing Image Processing
- When the color transfer doesn’t work well as a whole, separate the image into different swatches(clusters) and perform color transfer will do the tricks.

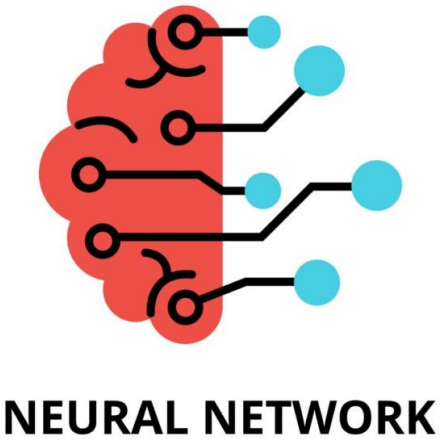
Fully Convolutional Network For Semantic Segmentation

What is Convolutional Neural Network ?

- Regularized type of feed-forward neural network that learns feature engineering by itself via filters optimization.

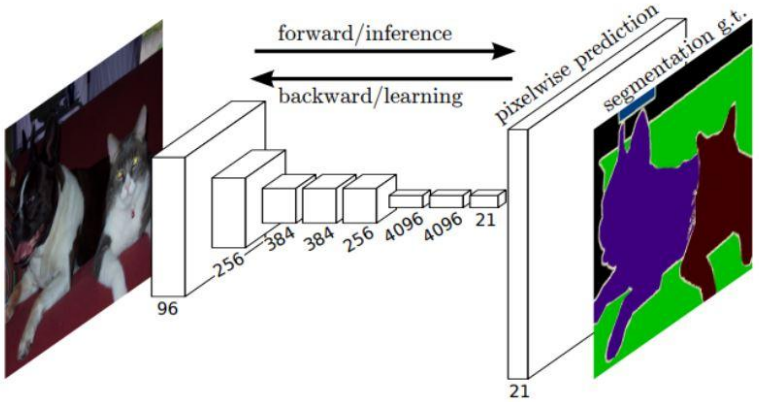
- It mainly consists of two main parts:

  (1) Convolution Layer,
  (2) Pooling Layer



Fully Convolutional Network?

- A type of CNN without any pooling layers.
- Able to work with all sizes of input images, more flexible than standard CNN.
- Standard CNNs can be easily converted to FCN by replacing the fully connected layers with convolutional layers



Problem: Fully Convolutional Network

First introduced by
Long et al. [6] in 2014

Image segmentation can be treated as a classification problem

Utilizing the feature map from the final convolutional layer as the score map for pixel classification

Direct application of FCNs is hindered by pooling and "valid" convolution, resulting in a coarse prediction map

Solution ?

Solution: Fully Convolutional Network

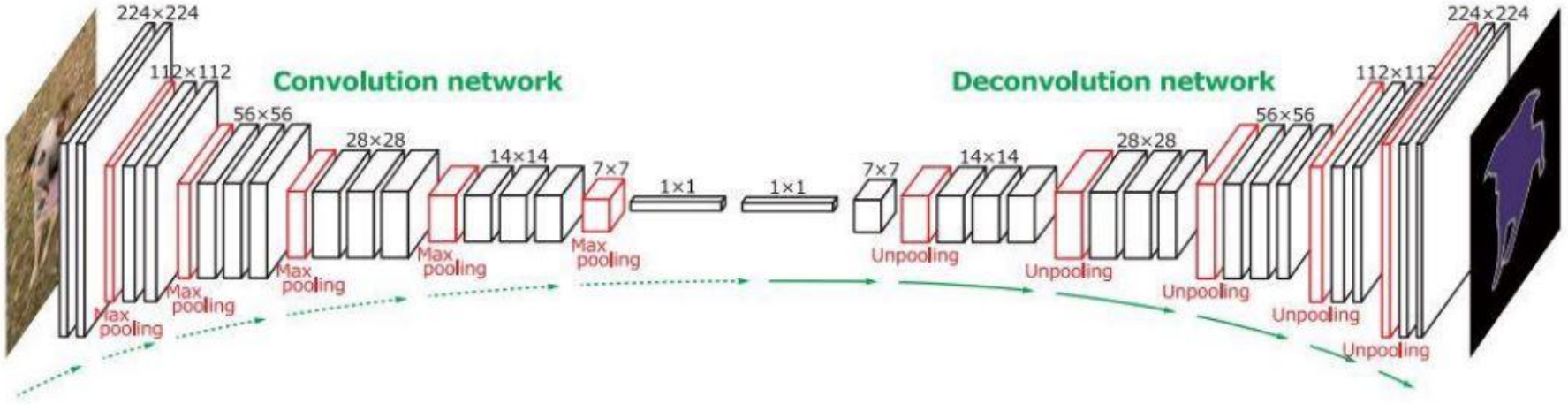
Deconvolutional layer is put at the end of FCN!

What is Deconvolutional layer?

Deconvolution is essentially an upsampling operation and it has several advantages over other upsampling methods:

1) deconvolution is nonlinear,
2) upsampling using deconvolution can be trained end-to-end in FCNs, and
3) deconvolution can be efficiently implemented using convolution.

Fully Convolutional Network



Takeaways: Fully Convolutional Network

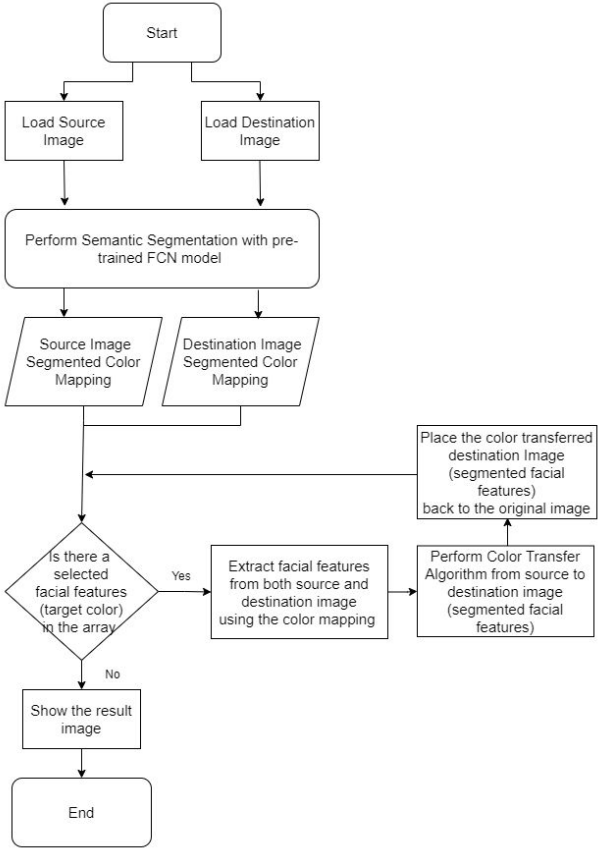
- Understanding of basic architecture behind the Fully Convolutional Network

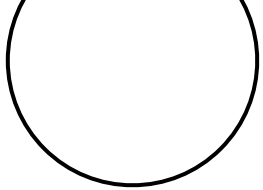
Vectorization-based Color Transfer for Portrait Images

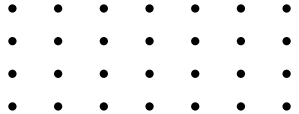
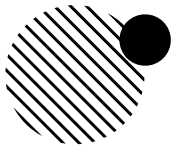
Takeaways: Vectorization-based Color Transfer

- Main purpose is to understand the flow/pipeline of performing digital makeup

Proposed Digital Makeup Pipeline



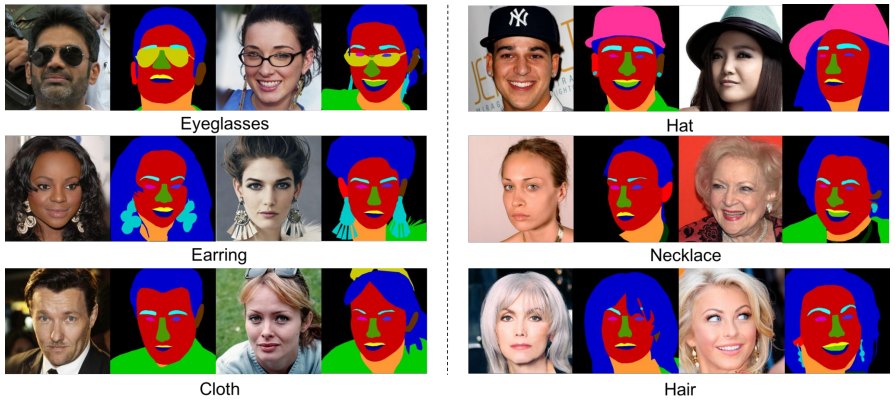



03
Tools Used

Programming Tools

Dataset Used: CelebAMask-HQ

- A non-commercial purpose of large-scale face image dataset.
- Each image has a segmentation mask of facial attributes.
- The masks were manually annotated with 19 classes including all facial components and accessories such as skin, nose, eyes, eyebrows, ears, mouth, lip, hair, hat, eyeglass, earring, necklace, neck, and cloth.



03½

Demo For Digital Makeup

04

Experiment & Result

Color Transfer Between Images

Pseudocode for the Algorithm

Pseudocode:

(1) Load source and destination(dest) images

(2) Convert both images into the matrix of color space RGB

(3) Calculate the mean and standard deviation of each color space for both images

(4) For each color space, perform the following calculations:

$$ColorSpace' = ColorSpace_{destination} - MeanColorSpace_{destination}$$

$$ColorSpace' = (StdDevColorSpace_{source} \div StdDevColorSpace_{destination}) \times ColorSpace'$$

$$ResultColorSpace = ColorSpace' + MeanColorSpace_{source}$$

(5) Merge the result color space back into images and return the result images

Experiment Conducted: Color Transfer

1. Color Transfer on Scenery Image (Color Image with Color Image)

2. Color Transfer on Scenery Image (Color Image with Grayscale Image)

Experiment 1 Result

	Source Image	Destination Image	Result Image
1.			
2.			

Experiment 2 Result

	Source Image	Destination Image	Result Image
1.			
2.			

Summary of Experiment

1. Succeed in transferring the color of one image.

2. To have a better result, we can perform semantic segmentation on images and perform color transfer parts by parts

3. Choosing the correct color space during image processing is also very important.

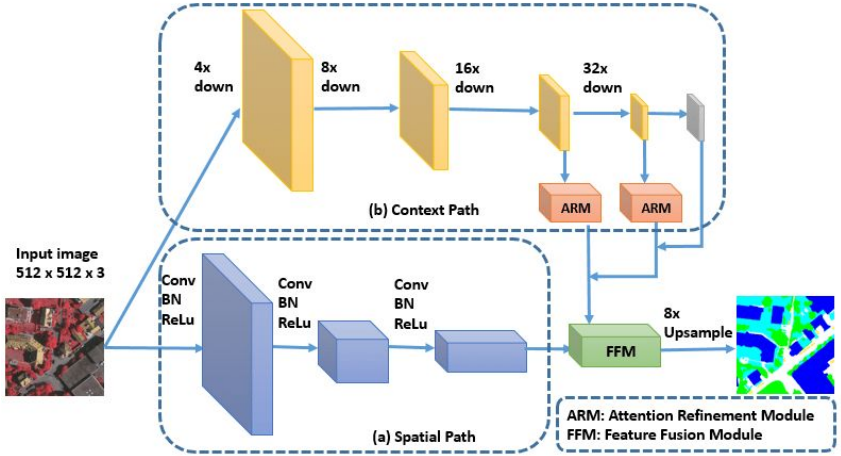
Semantic Segmentation using Pre-trained Model

Model Used for Semantic Segmentation

- Pre-trained Semantic Segmentation Model using BiSeNet as a Backbone
- Implemented using Pytorch library and trained with CelebAMask-HQ Dataset

What is BiSeNet?

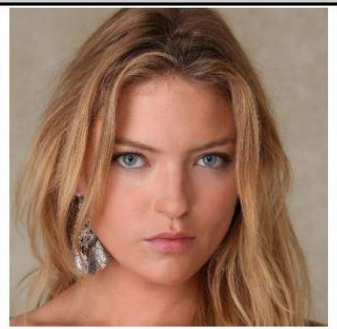
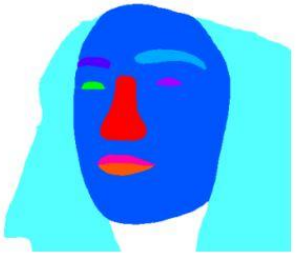
- An innovative approach introduced by Yu et al. [16]
- Featuring a distinctive two-way architecture comprising the Spatial Path (SP) and Context Path (CP).
- The purpose of the two paths is shown below:
  (1) SP reduce the loss of spatial information and retain more detailed information.
  (2) CP increase the receptive field.



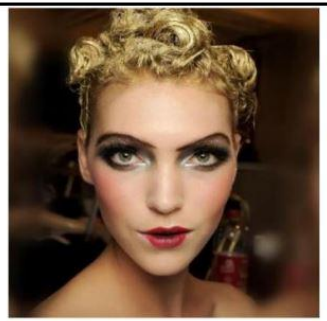
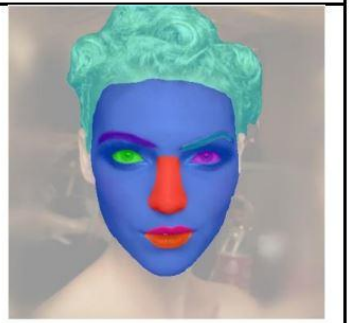
Experiment Conducted: Semantic Segmentation

1. CelebAMask-HQ Picture
2. Random Celebrity Picture (Front View)
3. Random Celebrity Picture (Side View)
4. 3D Anime Character Picture
5. 2D Anime Character Picture

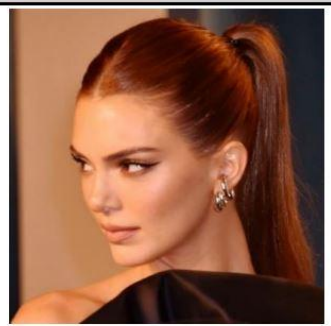
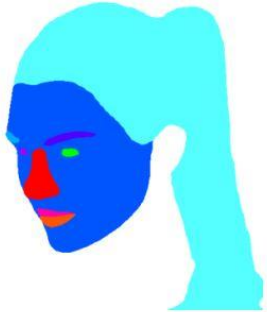
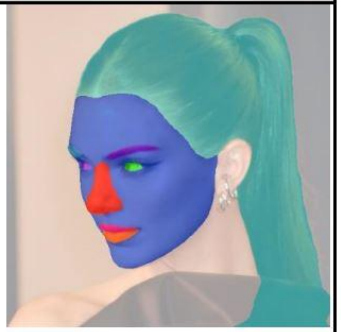
Experiment 1 Result

No.	Original Image	Color Mask/Mapping	Color Mapping on Original Image
1.			
2.			

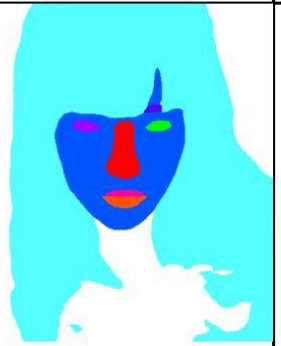
Experiment 2 Result

No.	Original Image	Color Mask/Mapping	Color Mapping on Original Image
1.			
2.			

Experiment 3 Result

No.	Original Image	Color Mask/Mapping	Color Mapping on Original Image
1.			
2.			

Experiment 4 Result

No.	Original Image	Color Mask/Mapping	Color Mapping on Original Image
1.			
2.			

Experiment 5 Result

No.	Original Image	Color Mask/Mapping	Color Mapping on Original Image
1.			
2.			

Summary of Experiment

1. Best in CelebAMask-HQ portrait, Moderate in Random Real Life Portrait and 3D Anime Portrait, Bad in 2D Anime Portrait.

2. Observed factors that will affect the precision
   (1) The person in the image is facing to the side.
   (2) The color between facial features is too similar (e.g. brown color with black color).
   (3) The makeup of a person.

3. Image with the person facing the front is preferable.

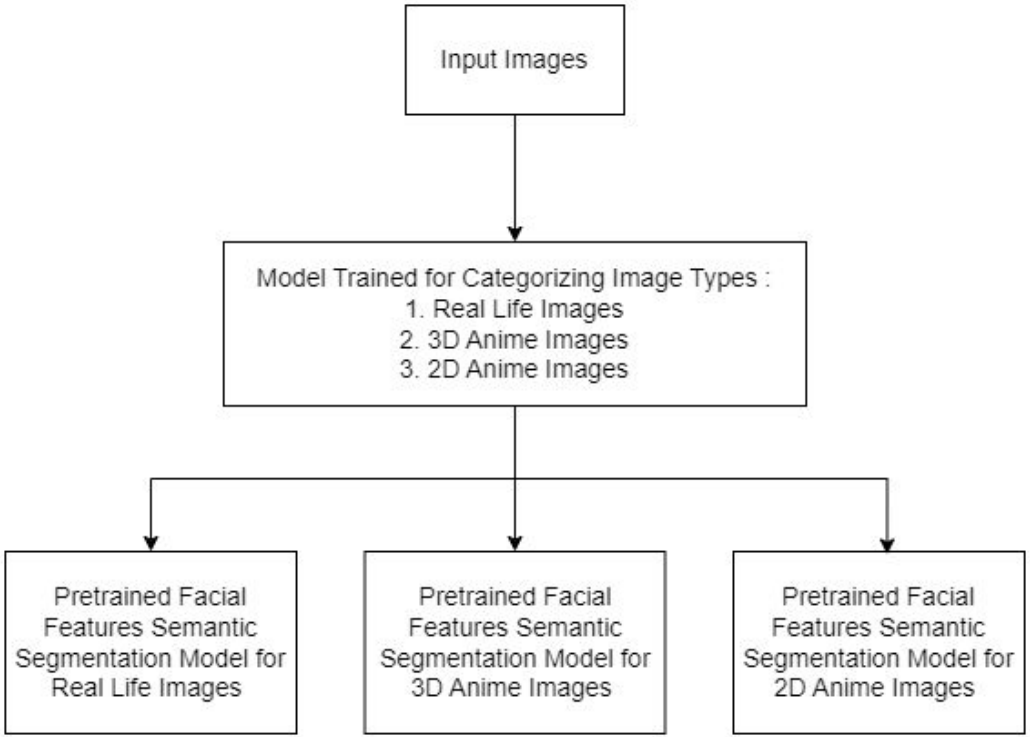
Summary of Experiment

Possible Solution for allowing facial features semantic segmentation on other different images like 2D anime character models:

1. Different machine learning models that have been trained for that specific type of images,

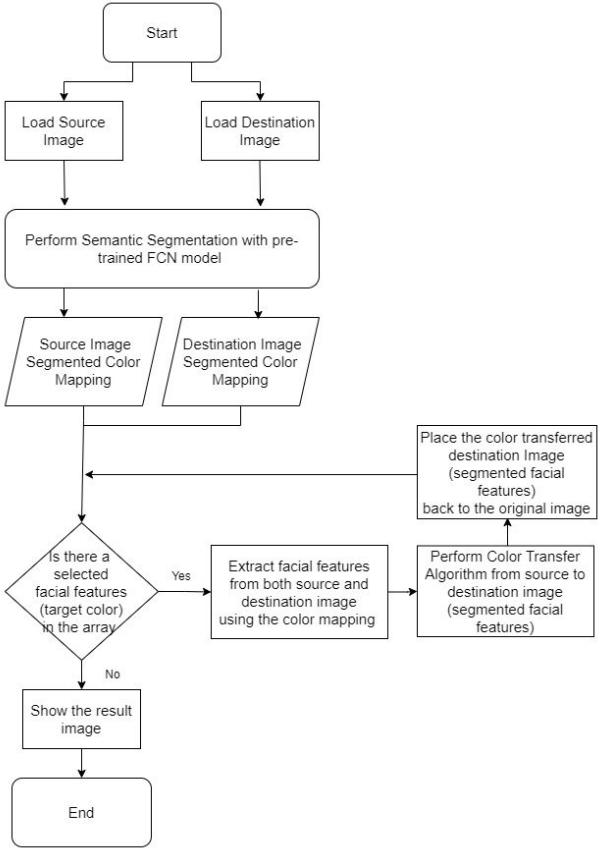
2. Machine learning model that is trained for categorizing each image into different types.

Summary of Experiment



Combining both works for Digital Makeup

Pipeline for Digital Makeup

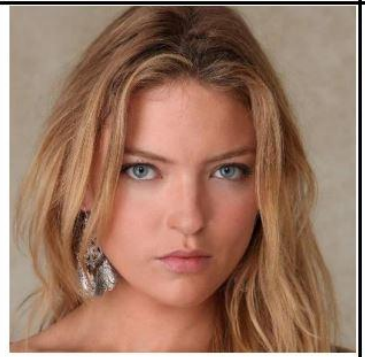


Experiment Conducted: Digital Makeup

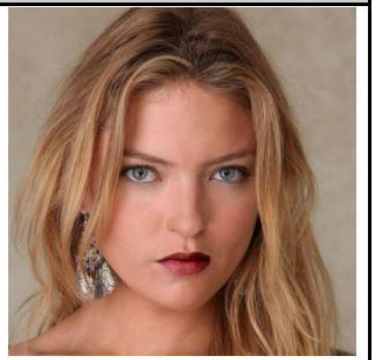
1. Hair Color Transfer

2. Lips Color Transfer

Experiment 1 Result

No.	Source Image	Destination Image	Result Image
1.			
2.			

Experiment 2 Result

No.	Source Image	Destination Image	Result Image
1.			
2.			

Summary of Experiment

1. Good result in performing digital makeup.

2. Some special cases where color transfer failed to get a decent result due to the special color.

Summary of Experiment

Possible reason:

Instead of just substituting the color of the destination image using the source image hair color, and what the algorithm does is calibrate the color of the destination image as a whole so that it can have the similar color as the source image

Summary of Experiment

Two possible solutions on this problem:

(1) We can train a machine learning model that can do further segmentation on the hair if there is a different hair color, and we can perform some image processing on the hair so that all segmented hair parts have the same color, and we continue back to the hair color transfer.

(2) We can train a machine learning model for color transfer which can solve this problem.

05
Conclusion

Conclusion

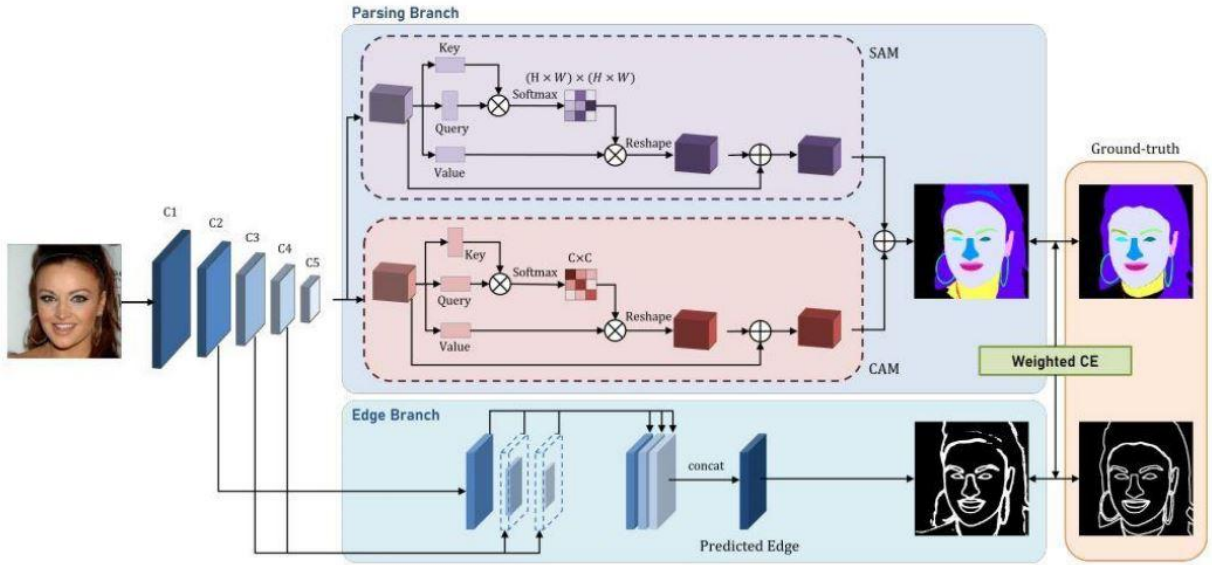
Successfully implemented algorithm for digital makeup and achieved favorable results.

Digital Makeup Pipeline:

1. Facial semantic segmentation.
2. Applied color transfer to the cropped facial regions.
3. Merge color-transferred facial parts back into the original image.

Future works

1. Pretrained SCANet semantic segmentation model.



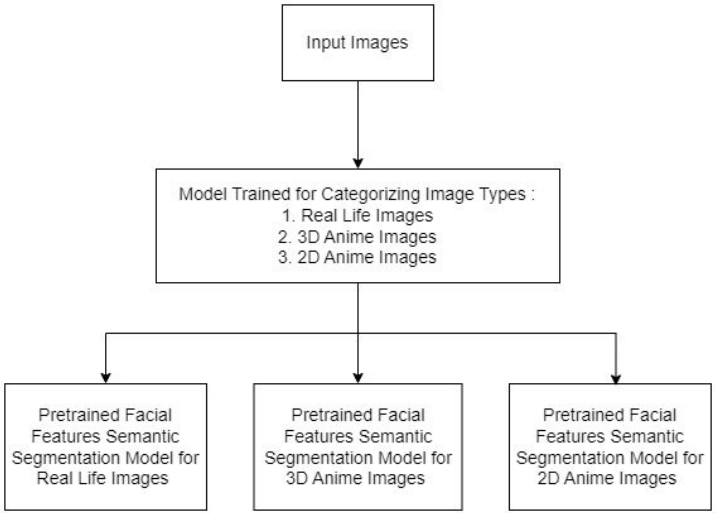
What is SCANet?

- Introduced in the 20th International Conference on Ubiquitous Robots (UR) in 2023.
- Features two distinct attention networks: the Spatial and Channel Attention Networks (SCANet)
- Effectively combine local features with global dependencies, emphasizing crucial contextual features.
- Perform well particularly in small facial features such as necklaces and earrings.
- Optimized for real-time operation

Future works

2. Machine Learning Model for Color Transfer.

3. Architecture for Semantic Segmentation for different types of pictures.



Thank You

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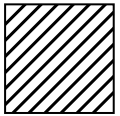


Our company

Who are you? What market do you focus on? Why do clients keep choosing you? Here’s a paragraph you can use to describe what makes you unique. Tell a compelling story about how your company was born and how it has developed to become what it is today

Our goals

Short term

Our main goals now are to increase sales through improved marketing and customer outreach, optimize operational processes to reduce costs and increase efficiency and establish a timeline for new products

Long term

The overall goal of the company is to expand into new markets or geographies, develop and implement a strategy to reduce environmental impact and increase sustainability and increase market share

What sets us apart?

Always on time

We never miss a deadline. You can rely on us and rest assured that your product will be ready on time

Out-of-the-box

Our out-of-the-box ideas are creative solutions that challenge the status quo and provide unique value

Customer service

We focus on providing a high level of customer service so that the experience is positive

Our guiding principles

Integrity

For us, integrity means operating with honesty, trustworthiness, and strong moral values. We commit to ethical and environmental standards

Customer focus

We put customers at the center of everything they do. We listen to customer feedback and incorporate it into decisions, products and services

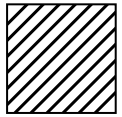
Collaboration

We create an environment where employees can work together productively and efficiently to achieve common objectives. It involves sharing knowledge, skills, resources, and ideas

Innovation

Innovation is an integral part of our company’s culture and is essential for success. It means us coming up with new ideas, methods, and products that can grow the business

Competitor analysis



Features

Compare features and benefits of your product

Pricing

Analyze your competitors' pricing and offers

Customer feedback

Examine the feedback on their products

Monitoring

Keep an eye on their offers and product launches

Emerging trends

Identify any emerging trends in your industry

Organic search

How are your competitors optimizing their SEO?

333,000

New Instagram followers

5m 23s

Average reading time on our posts

3 languages

We publish our content in different languages for more reach

123,123

New leads during the last month

Market share

Here’s the market share of our industry

Market share is the percentage of a market that is controlled by a particular company or industry. It is calculated by dividing the total sales revenue of a company by the total sales revenue generated in the entire industry

30%

Us

20%

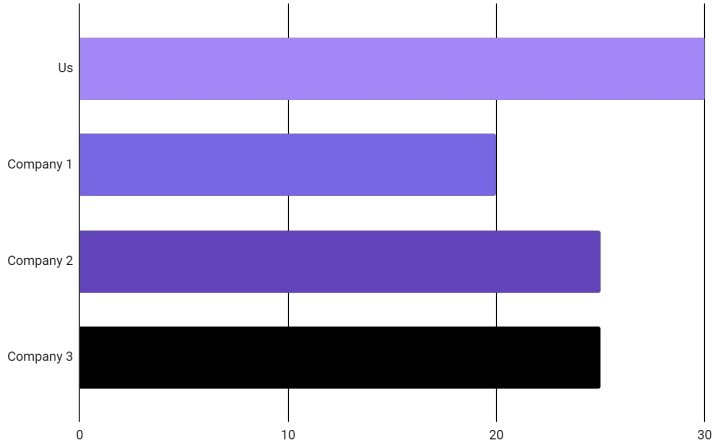
Company 1

25%

Company 2

25%

Company 3



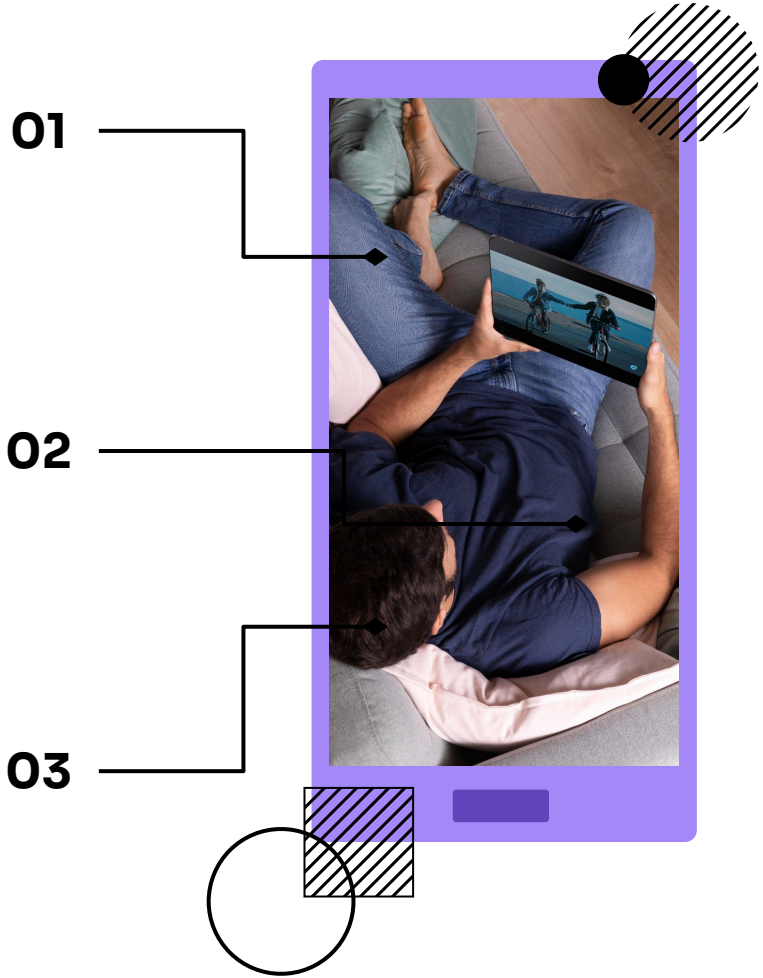
Follow the link in the graph to modify its data and then paste the new one here. **For more info, click here**

Key action items

	First quarter	Second quarter	Third quarter
Key action 1	Create detailed procedures	Monitor and review process performance	Measure the effectiveness of processes
Key action 2	Use data analytics to gain insights	Develop strategies in order to reduce waste	Stay up to date with new technologies and trends
Key action 3	Invest in technology solutions for automation	Establish control of spend and reduce overhead	Foster an environment of collaboration
Key action 4	Focus on continuous improvement	Ensure proper management of resources	Research market best practices from outside

What to show in a mockup

1. Product/website description: a brief overview of the product/website, including its key features, dimensions, and materials used
2. Features and benefits: a detailed explanation of the features and how they will benefit the user
3. Technical specifications: a list of the product's/website's technical specifications, such as dimensions, weight, power requirements, connectivity options and hosting platform, among other features



Buyer persona infographics

Name

Age and occupation

“This is a quote, words full of wisdom that can make the reader get inspired”

Bio

Make a short description of what a typical customer would be. Be precise!

Pain points

Knowing your buyer persona’s pain point will help you create messages that are tailored to their needs

Motivations

01 Creativity

02 Ecology

03 Music

04 Business growth

Personality

- Explorer, adventurous. Likes the outdoors and camping
- Engaged on social media, speaks for themselves
- Not easily influenced by ads or social media
- Passionate, determines and driven for goals

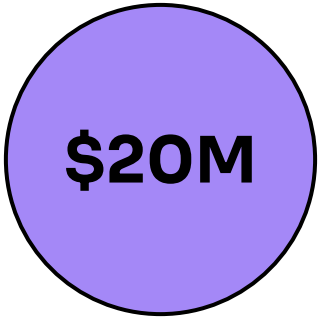
Roadmap infographics

Initiative	Objective	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Understanding	Analyze and understand the needs of your target audience												
Conduct research	Research existing products in the industry and analyze how successful they are												
Brainstorm ideas	Generate ideas based on user feedback and research findings												
Develop a prototype	Create a basic version of the product to show investors												
Test for usability	Put the prototype through rigorous testing processes to ensure that it meets user requirements												
Analyze feedback	Understand the opinion of users who tried your product												

Market size overview

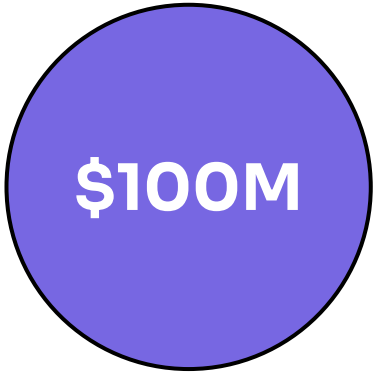
SOM

Indicate the current market size, which represents the portion of the target market that the company has successfully captured



SAM

Identify the target market for the product or service, which may be a subset of the total market. This could be based on factors such as demographics, geography, or specific needs



TAM

Include the total size of the market, which represents the entire potential customer base for the product or service

Social media stats

Platforms with most users

xxx billion

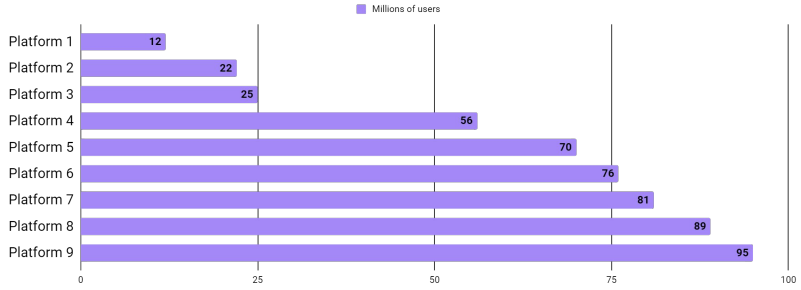
Users worldwide

xh min

Average time spent

xx

Number of platforms used



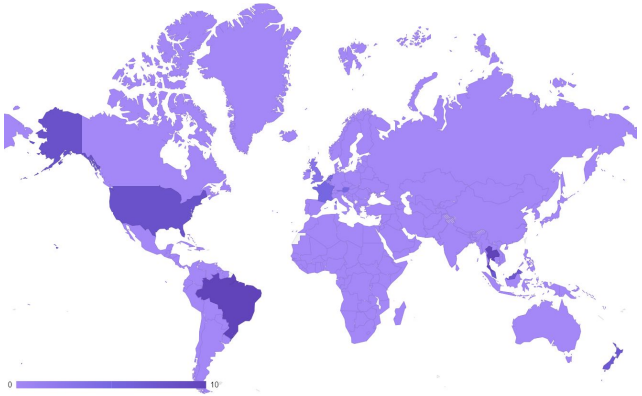
Worldwide reach

xxx billion

Country 1 users

xxx billion

Country 2 users



Follow the link in the graph or the map to modify its data and then paste the new one here. **For more info, click here**

Case studies

Approach

- Preparing a set of posts and stories we can share on Instagram to let more people know about our brand
- We can get shared more and maybe reach virality if our content is attractive and easy to share

Instagram giveaway

A special product giveaway for our second anniversary

Key takeaway 1

Content posted on weekdays is shared more

Key takeaway 2

We must design new content to keep new users

Results

23%

Increase in shares

80%

Increase in followers

10%

Increase in clicks

Thanks

Do you have any questions?

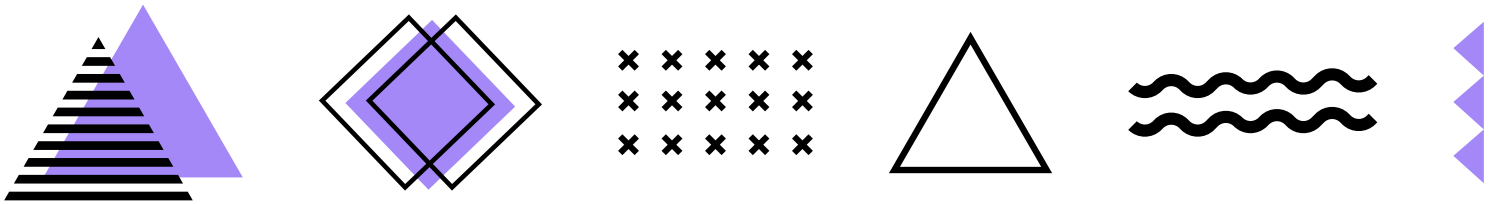
youremail@freepik.com
+91 620 421 838
yourwebsite.com

Alternative resources

Here’s an assortment of alternative resources whose style fits that of this template:

Vectors

- Geometric shapes background in flat design



Resources

Did you like the resources used in this template? Get them on these websites:

Vectors

- Science template design I
- Science template design II
- Science template design III

Photos

- Medium shot young man making podcast
- Man watching streaming service on his tablet
- Person of indian origin having fun

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This presentation has been made using the following fonts:

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(https://fonts.google.com/specimen/Sora)

Noto Sans
(https://fonts.google.com/noto/specimen/Noto+Sans)

Storyset

Create your Story with our illustrated concepts. Choose the style you like the most, edit its colors, pick the background and layers you want to show and bring them to life with the animator panel! It will boost your presentation. Check out **how it works**.

Pana

Amico

Bro

Rafiki

Cuate

Use our editable graphic resources...

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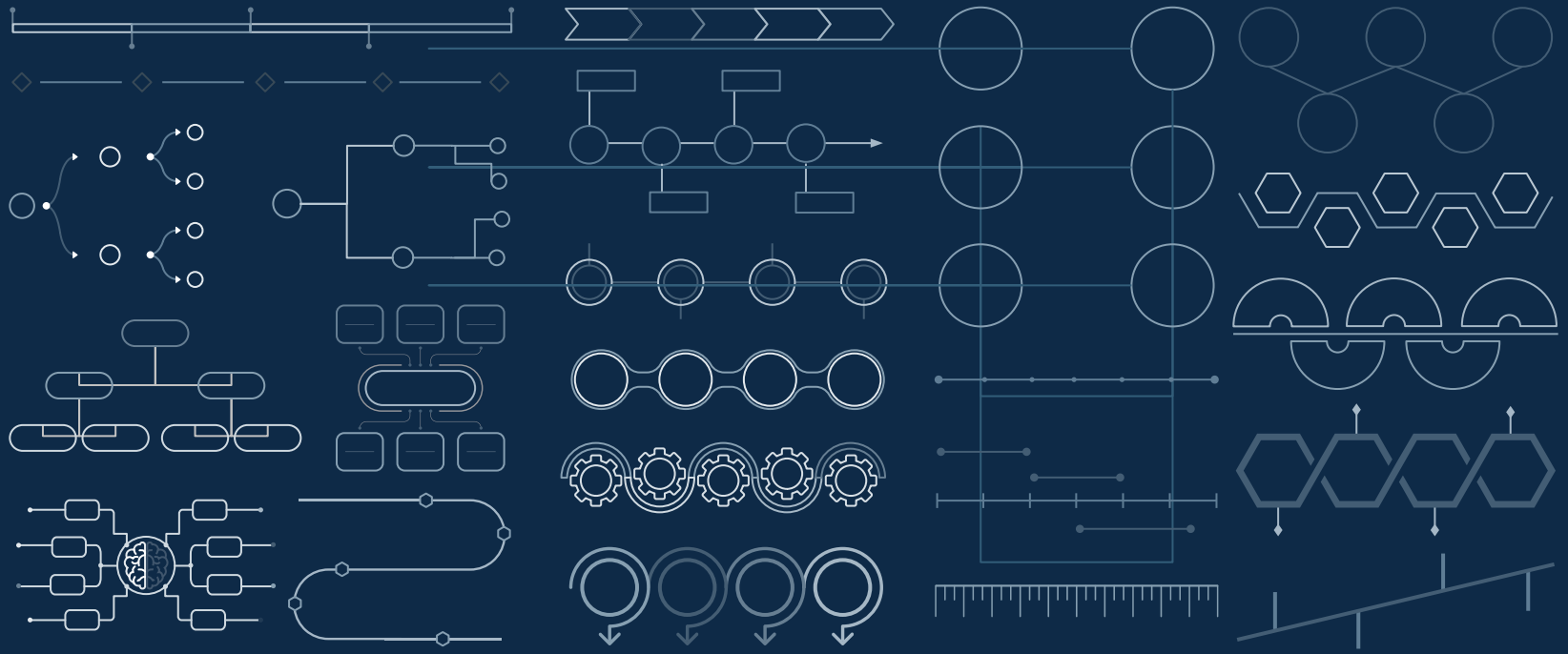

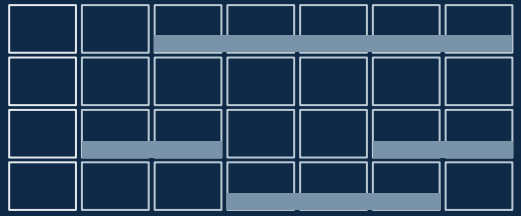

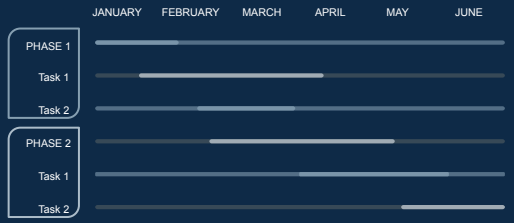
JANUARY
FEBRUARY
MARCH
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PHASE 1
Task 1
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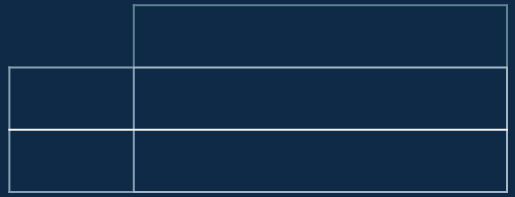
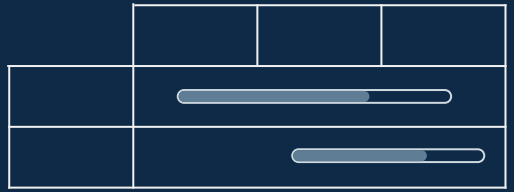
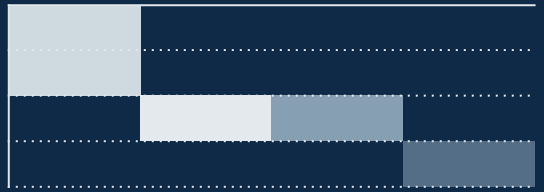
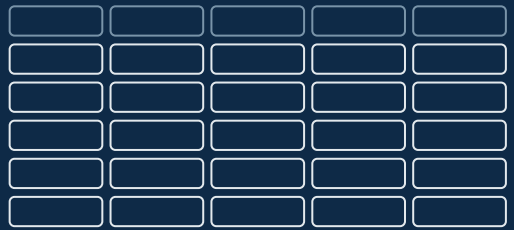
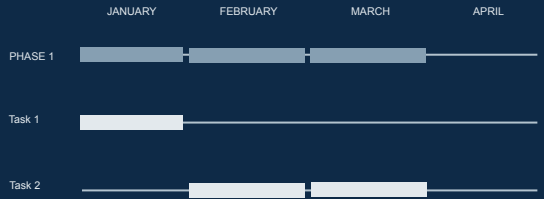
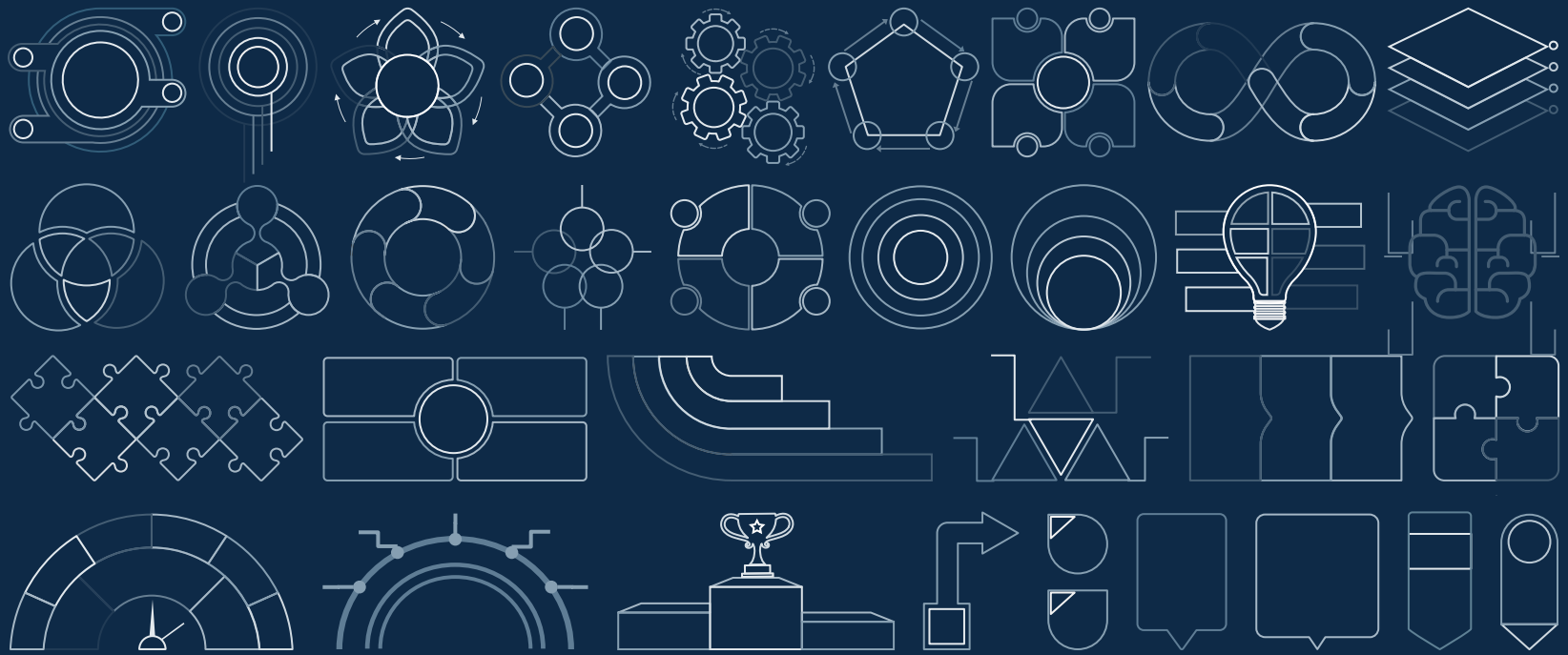


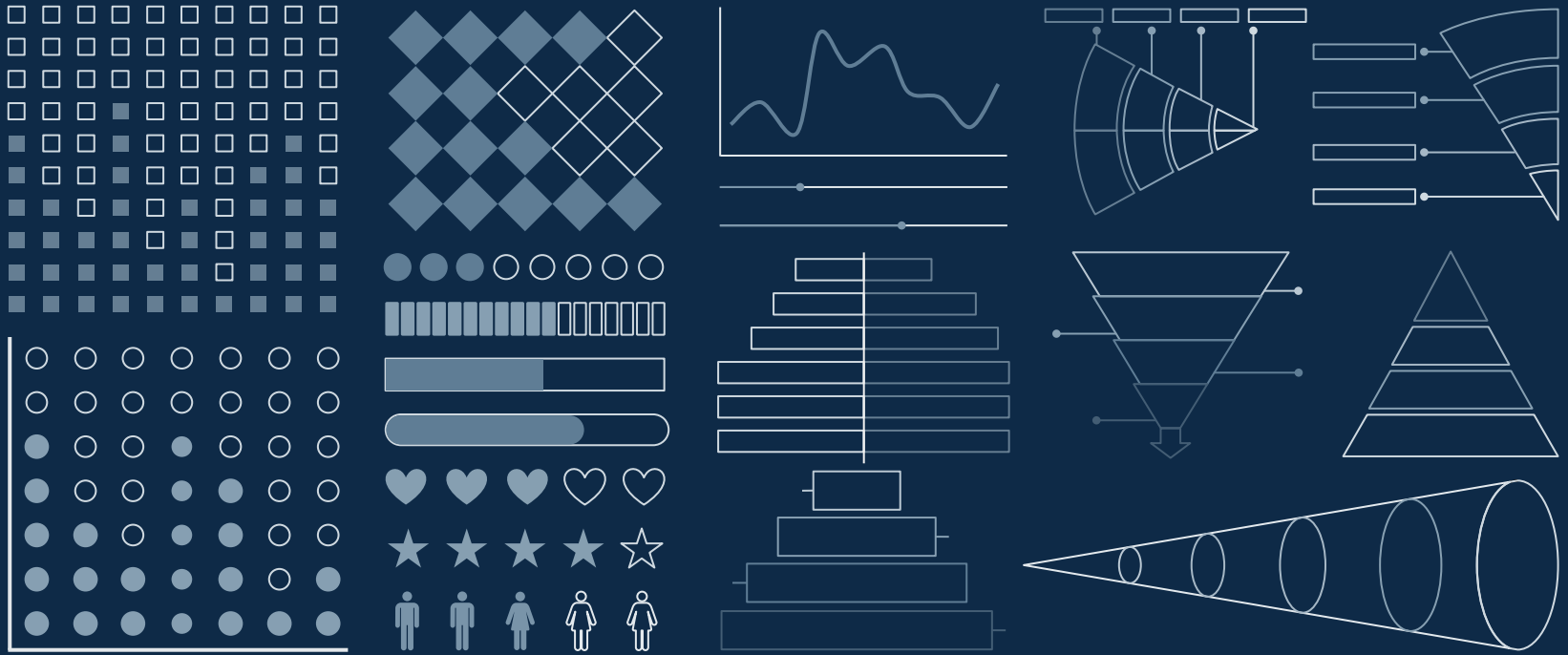







JANUARY
FEBRUARY
MARCH
APRIL
PHASE 1
Task 1
Task 2





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