Smart Mirror Fashion AI

Data 298B Final Project Demo

Team 8
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1 Intro and Motivation

Potential Opportunity

According to Fashion United, the global fashion industry is estimated to be worth $3 trillion. Which is equal to 2% of the global Gross Domestic Product (GDP).

AI Application

Fashion retail businesses have incorporated artificial intelligence (AI) technologies into their market strategies to optimize sales and customer experience.

Our Model

Four sections:
Garment Segmentation
Human Pose Estimation
Garment Warping
Image Generation

2 Literature and Technology Survey

Product comparison based on market research on currently available virtual fitting products

Ref. ID	Product	Key Features	Model	Customer
[47]	Memory Mirror	• 360 degree video recording try-on history • Instant change of clothing colors and patterns virtually • Personalized recommendation • Instant online shop	Real Person Reflection	Neumen Marcus
[48]	Fashion Navi Mirror	• Personalized avatar • QR-code to scan items and try-on virtually • In-store mirror platform and online • Instant online shop	3D Avatar	GU Style Studio

2 Literature and Technology Survey

Virtual Fitting Model Comparison

Summarize the key points from the research paper, description, models and performance

Ref. ID	Title	Description	Model	Base Model	Performance
[30]	SwapNet: Image Based Garment Transfer	Interchange garment appearance between two images while preserving pose, with IS of 3.04 compared to GAN models	SwapNet	U-net	***Inception Score (IS)***
					SwapNet: 3.04 CGAN: 2.11
					SSIM
					SwapNet: 0.83 CGAN:0.22
[29]	Image-based Virtual Fitting Room	Detecting, changing the texture and style of clothing items. Compared to other models, Mask R-CNN achieves mAP of 68.72% and NST of 0.2%	NST	Mask R-CNN, Image Style Transfer CNN	***mAP***
					Mask R-CNN: 68.72% FCN-CRF: 66.70% PaperDoll: 33.34%
					ASDR
					NST: 0.2% Encoder-Decoder: 1.2% PRGAN:4.2% CAGAN: 4.8%

2 Literature and Technology Survey

Literature Review in Fashion AI Related Applications

Ref. ID	Title	Target Problem	Application	Model & Algorithm
[6]	Tiered Deep Similarity Search for Fashion	Retrieving similar clothes based on brand, attributes and category.	Visual Search	AGML, Multitask-CNN
[7]	DeepFashion: Powering Robust Clothes Recognition and Retrieval with Rich Annotations	Identifying clothing items and features from street photos.	Visual Search, Classification, Recommendation	FashionNet, Siamese CNNs, BPR
[8]	Cross-domain Image Retrieval with a Dual Attribute-aware Ranking Network	Retrieving the same or similar attribute clothing items from photos of complex backgrounds.	Visual Search, Recommendation	CNN, DARN

3 Team and Project Requirement

Xiaocen Xie

Cloth segmentation

Mask RCNN

Mavis Wang

Human pose & body detection

DensePose RCNN

Ililta Gebrihiwet

Cloth warping

Thin-Plate Spline warp

Coco Yu

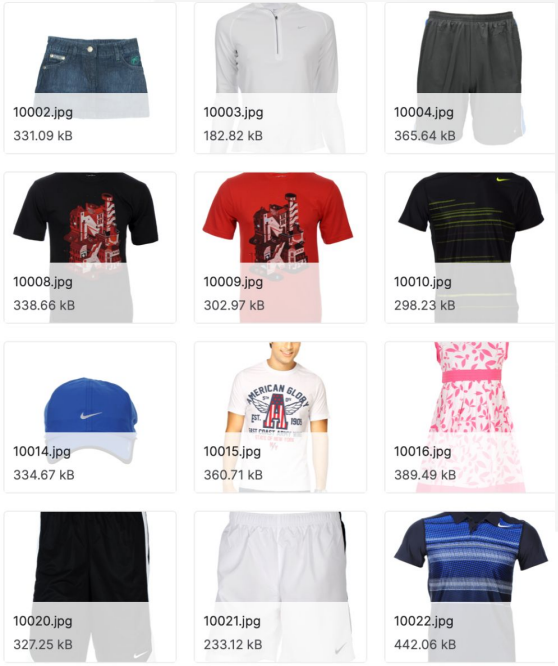
Image generation

CP-VTON

4 Data Engineering

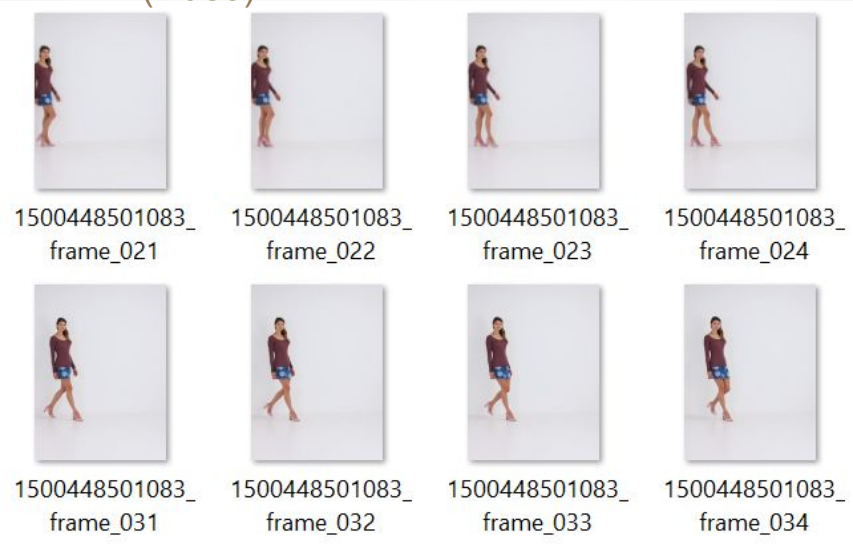
Small-scaled Dataset

Fashion Product Images



Benchmarking Dataset

VVT - LIP (video)



VTON (CP-VTON+)

4 Data Engineering

The preprocessing contains two parts:

- product image selection
- style annotation filtering

Sample raw data of fashion product image URLs of FPI dataset

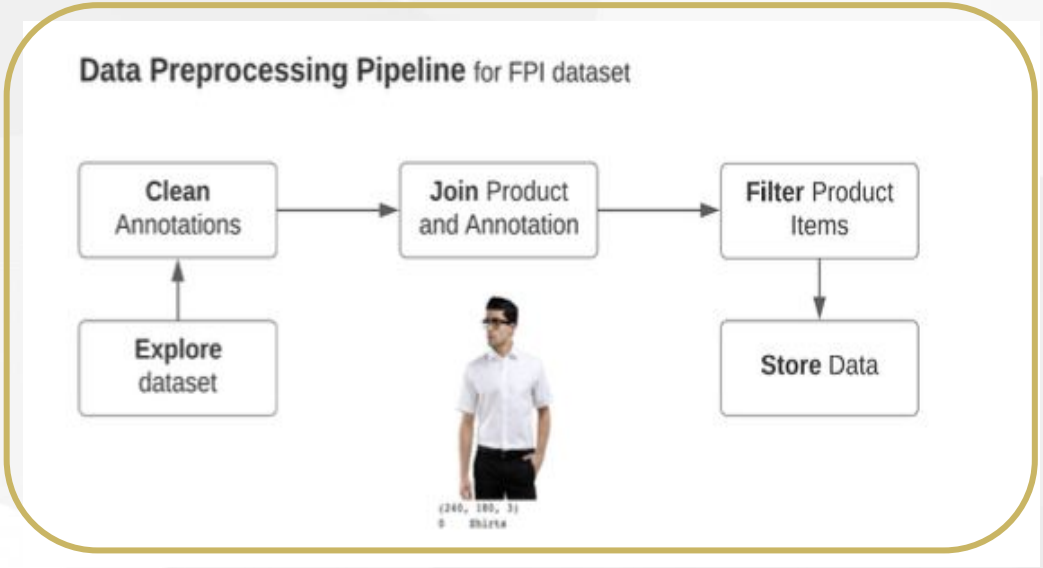
	filename	link
0	15970.jpg	http://assets.myntassets.com/v1/images/style/p...
1	39386.jpg	http://assets.myntassets.com/v1/images/style/p...
2	59263.jpg	http://assets.myntassets.com/v1/images/style/p...
3	21379.jpg	http://assets.myntassets.com/v1/images/style/p...
4	53759.jpg	http://assets.myntassets.com/v1/images/style/p...

Sample annotations of the fashion product in tabular format from FPI dataset

	id	gender	masterCategory	subCategory	articleType	baseColour	season	year	usage	productDisplayName
0	15970	Men	Apparel	Topwear	Shirts	Navy Blue	Fall	2011.0	Casual	Turtle Check Men Navy Blue Shirt
1	39386	Men	Apparel	Bottomwear	Jeans	Blue	Summer	2012.0	Casual	Peter England Men Party Blue Jeans
2	59263	Women	Accessories	Watches	Watches	Silver	Winter	2016.0	Casual	Titan Women Silver Watch
3	21379	Men	Apparel	Bottomwear	Track Pants	Black	Fall	2011.0	Casual	Manchester United Men Solid Black Track Pants
4	53759	Men	Apparel	Topwear	Tshirts	Grey	Summer	2012.0	Casual	Puma Men Grey T-shirt

4 Data Engineering

1. Data Exploration
2. Cleaning the annotation table
3. Join tables
4. Filter fashion product
5. Reconstruct and store data

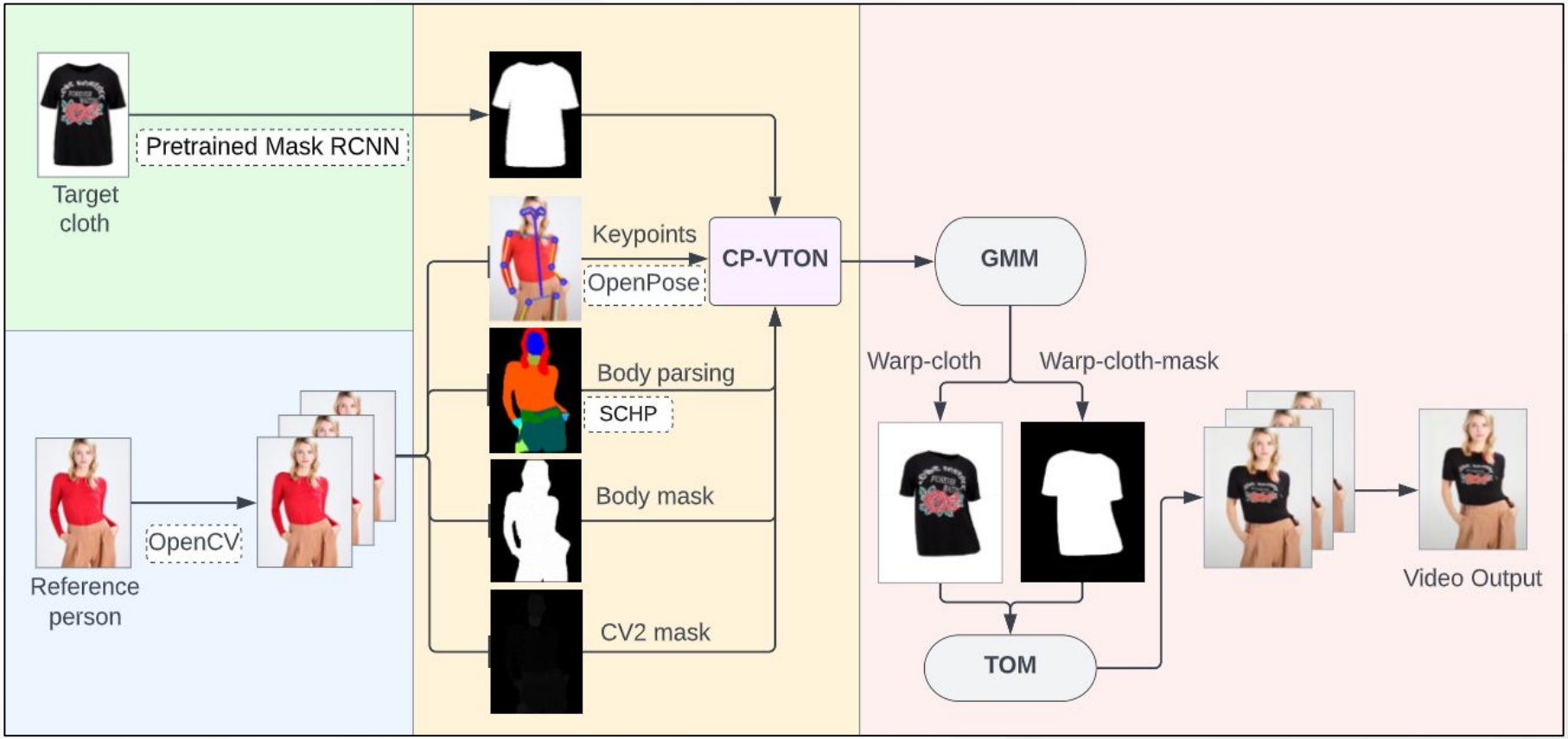


4 Data Engineering

Samples of the preprocessed data for training and evaluation of the proposed virtual fitting network module:

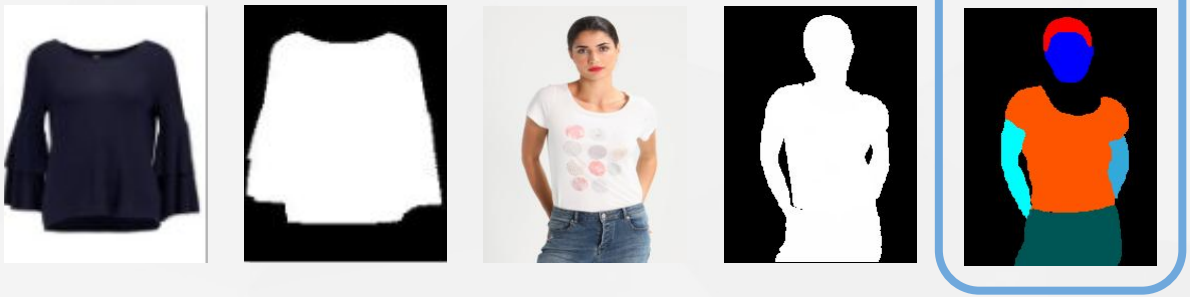
- Segmentation

5 Machine Learning Modeling

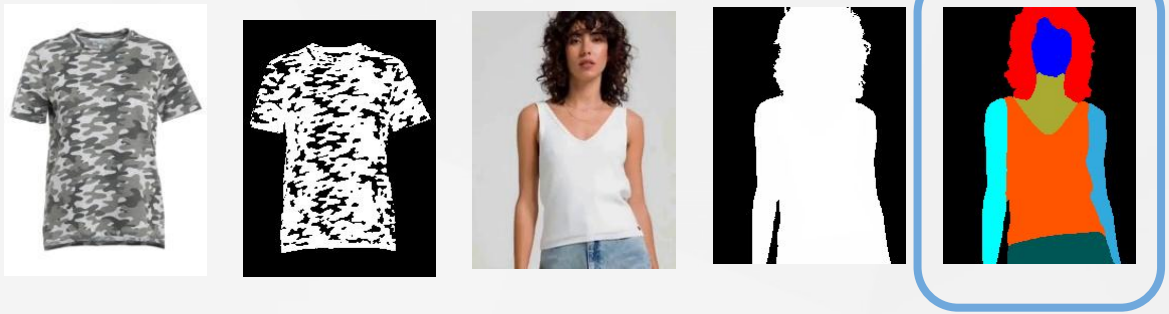


5 Machine Learning Evaluation Results

Cp-vton-plus test dataset



Our test dataset (images)



5 Comparative Results of Models

Inference time	
Model	Average Inference Time
RCNN (Body Parsing)	0.083s on CPU
R50FPN (Pose Estimation)	0.089s on CPU

CPVTON+

Model Runtime	
Model	Runtime (step/sec)
GMM (Warping Cloth Module)	0.06s on GPU
TOM Try-on Module - Unet	0.067s on GPU

5 Machine Learning Evaluation

```
!python  ssim.py  -f  /content/Structural-Similarity-Index-SSIM-/images/000002_0.jpg
  -s  /content/Structural-Similarity-Index-SSIM-/images/000002_1.jpg
```

```
SSIM: 0.6233211832886018
```

SMFAI

- Structural Similarity Index: 0.62
- Compare input clothes and output person

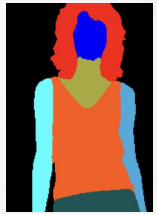
6 Machine Learning **Testing Results**

Testing

- Images
- Video


Improvement

- Fine-tuned OpenPose
- Fixed Neck Parsing

Comparison

- CP-VTON
- ShineOn
- Ours



6 Testing **Dataset**

Person

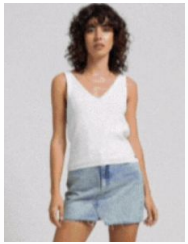
- VVT
- Online Shop Video
- Custom Video

Cloth

- FPI
- Amazon Shop
- VTON

6 Testing **Video Frames**

ref person

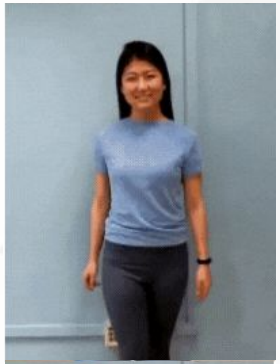


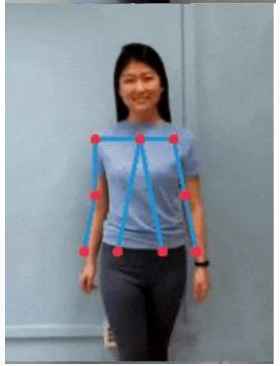
Data source: Superdry Inc.

6 Testing **Shop Video**

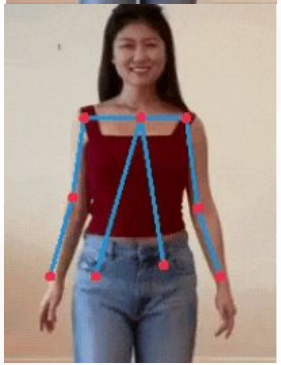
Data source: Superdry Inc.

6 Testing **Custom Video**

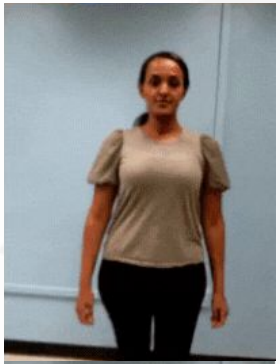


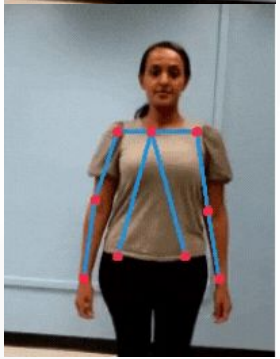


6 Testing **Custom Video**



6 Testing **Custom Video**





6 Testing **Summary**

Ref. Video

- Black outfits do not transfer well.
- Uneven video lighting will. interfere optical flow.
- Image resolution will affect quality of parsing result.
- Camera view works better with the front-angle.

Cloth Image

- Collar and hems
- Color and Style Complexity
- Only Trained with Tops

6 Testing **Evaluation**

Parsing

- Model: SCHP
- mIoU on LIP test set: 82.29%.
- 18 parts + neck parsing

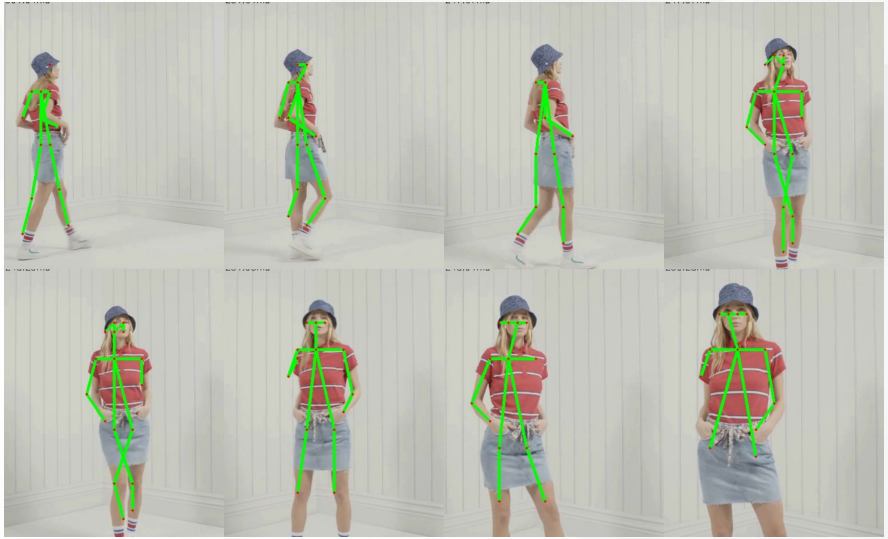
Alignment

- Model OpenPose
- Self-supervised
- 18 fine-tuned densePose Coco key-points

GMM and Try-On

- Model: CP-VTON+
- IoU: 0.8425 on VTON test set
- SSIM: 0.8163

6 Improved **Keypoint Detection**



Sample pose tracking test result with sequential video frames using pre-trained OpenPose.

The self-supervised performance was improved after adjusting hyperparameters of confidence, mean SD and fps.

Data source: Superdry Inc.

6 Improved **Keypoint Detection**

Pre-trained OpenPose keypoint detection.

Fine-tuned CocoPose keypoints detection result.

https://github.com/CMU-Perceptual-Computing-Lab/openpose

6 Improved neck **parsing**

CP-VTON and **ShionOn** exclude neck area for body parsing.

Our model includes **neck** area for human parsing.

https://github.com/GoGoDuck912/Self-Correction-Human-Parsing

6 Model Comparison **VVT dataset**

Cloth	Person	CP-VTON	ShineOn	Ours
				
				

https://github.com/andrewjong/ShineOn-Virtual-Tryon, https://github.com/sergeywong/cp-vton, https://github.com/SJSUMS/SMFAI

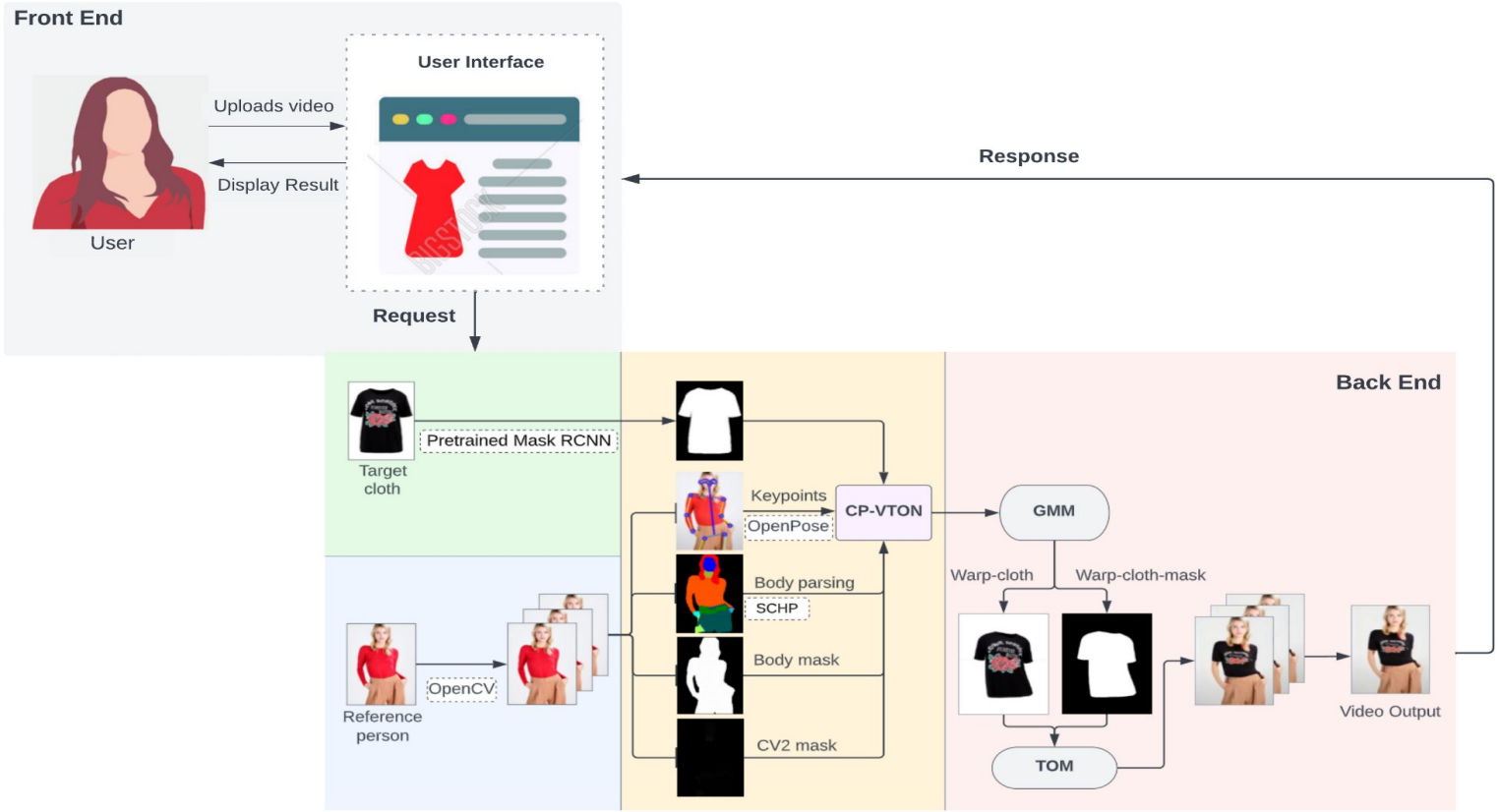
6 Model Comparison **VVT dataset**

Cloth	Person	CP-VTON	ShineOn	Ours
		 	 	

7 System Architecture Design

- System Architecture
- Web Development Architecture
- Demo

7.1 System Architecture



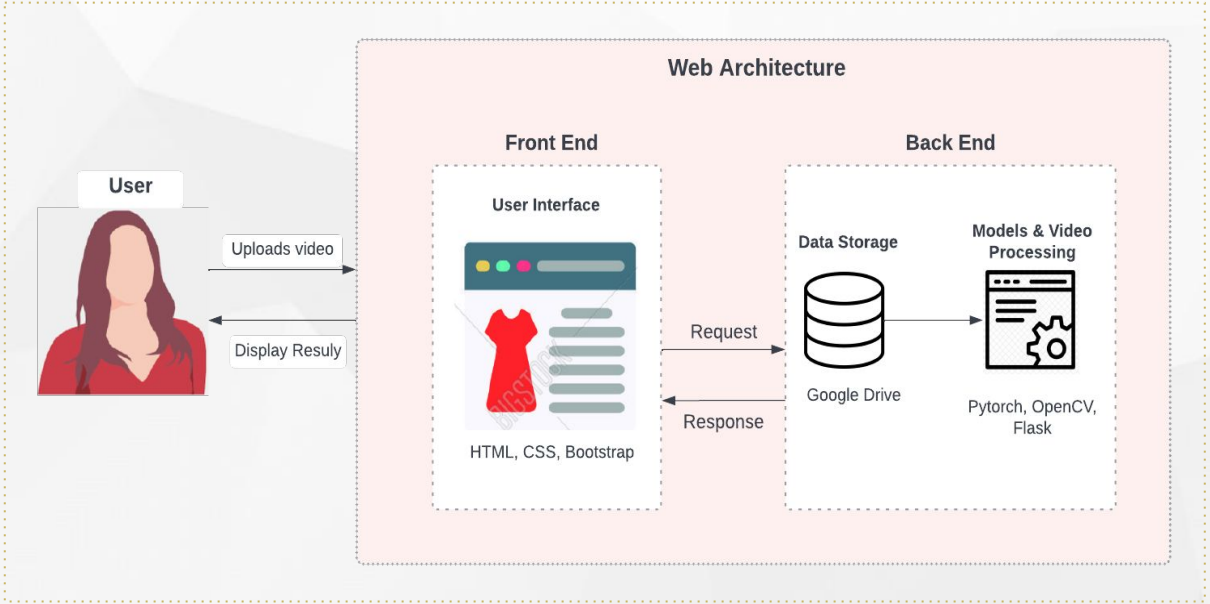
7 Web Portal System Development

Front-End:

- **GUI:**
  User uploads video.
  Displays the video try-on result using local HTTP response.

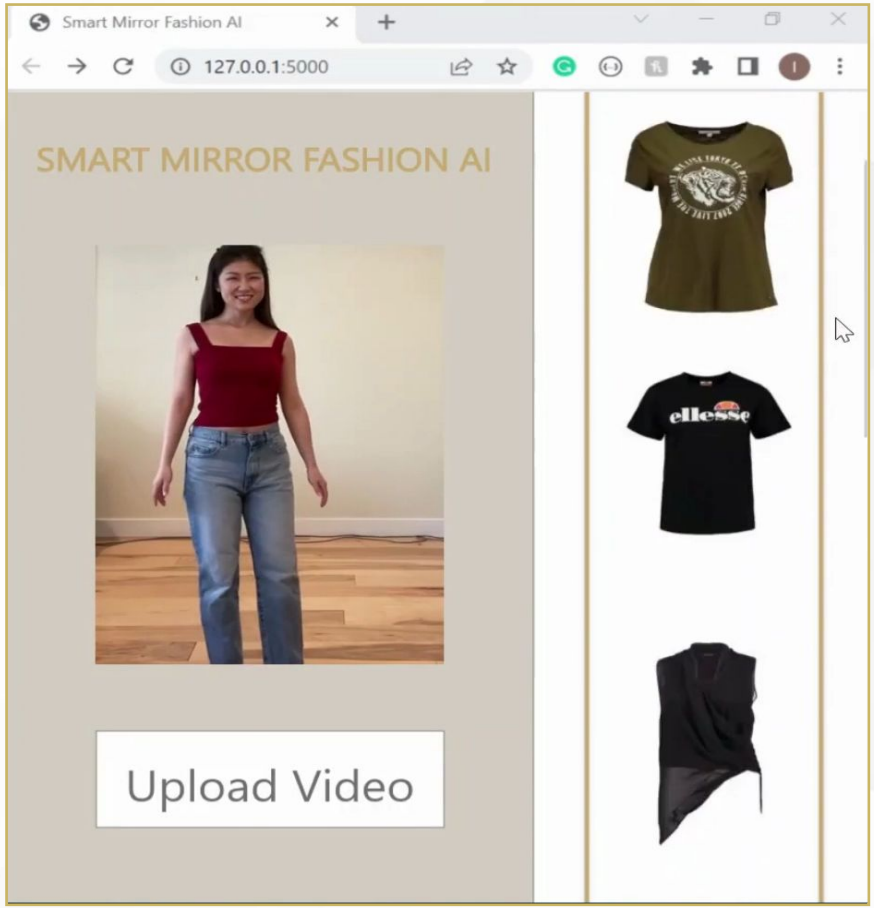
Back-End:

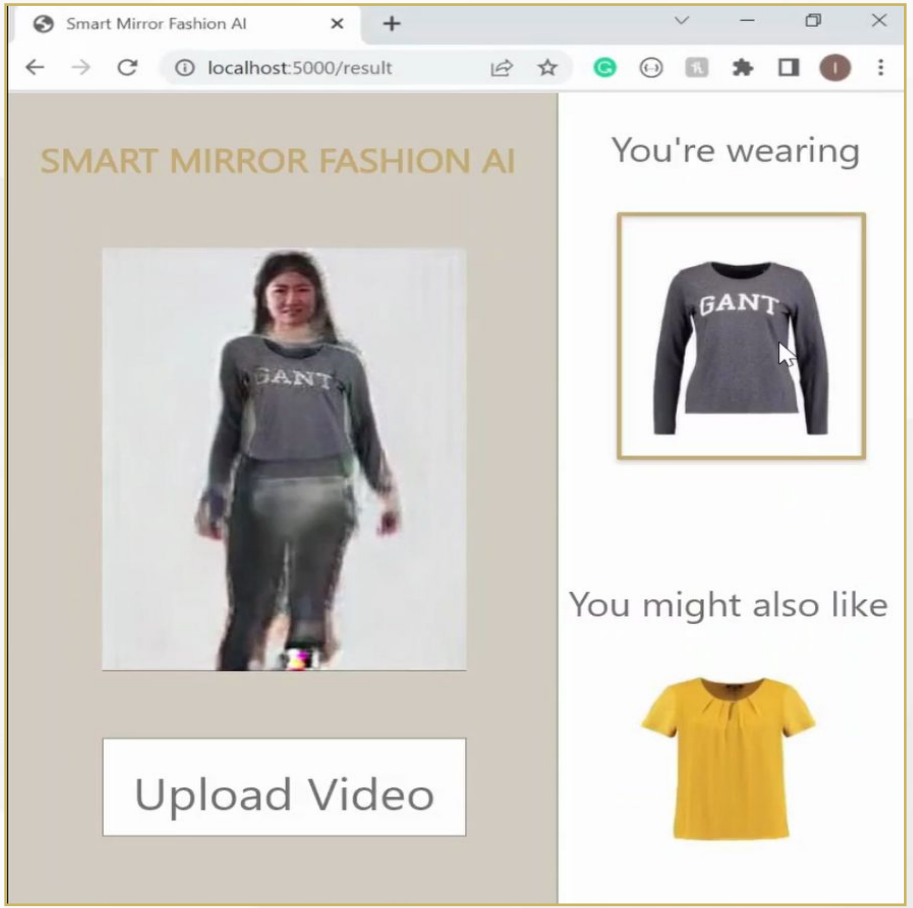
- **Algorithms module:**
  Implements virtual try-on model and generates video based try-on using OpenCV
- **Web framework**:
  Integrates try-on system and the UI using Flask framework.



OpenCV PyTorch Flask web development, one drop at a time Google Drive

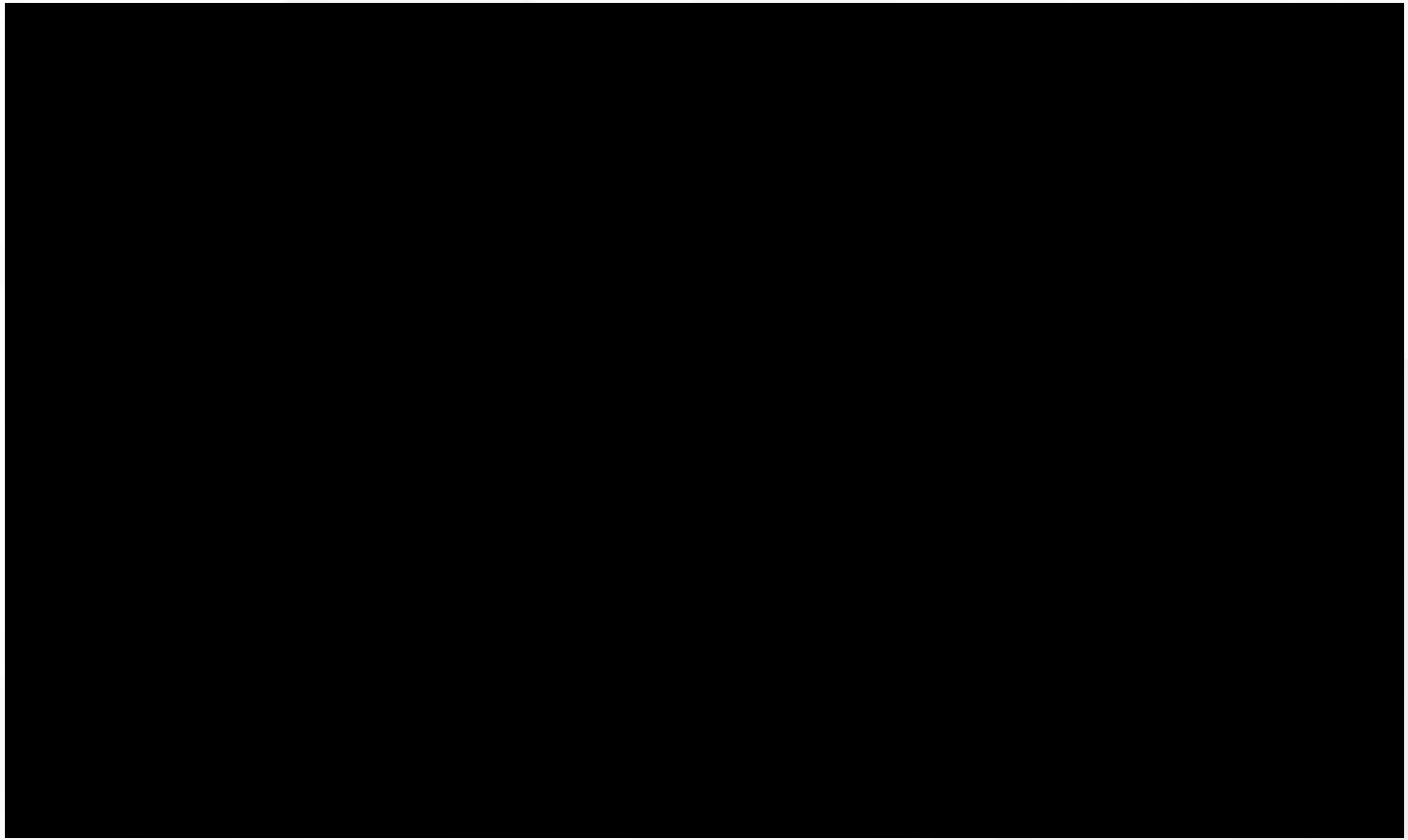
7 Web GUI


Smart Mirror Fashion AI
127.0.0.1:5000
SMART MIRROR FASHION AI
Upload Video


Smart Mirror Fashion AI
localhost:5000/result
SMART MIRROR FASHION AI
Upload Video
You're wearing
GANT
You might also like

8 System and Web App Demo

8 System and Web App Demo



9 Future Work

- Improve temporal consistency to achieve real-time virtual try-on
- 3D orientation to view garment at multiple angles
- Add features such as size measurement, personalized recommendation, visual search and style prediction

https://github.com/SJSUMS/SMFAI

Thank You!
Q & A

Smart Mirror, Smart Life