VISVESVARAYA TECHNOLOGICAL UNIVERSITY
“Jnana Sangama”, Belagavi-590018

Virtual 3D Trial Room

Department of Computer Science & Engineering
K. S. Institute Of Technology

Batch No. : 20

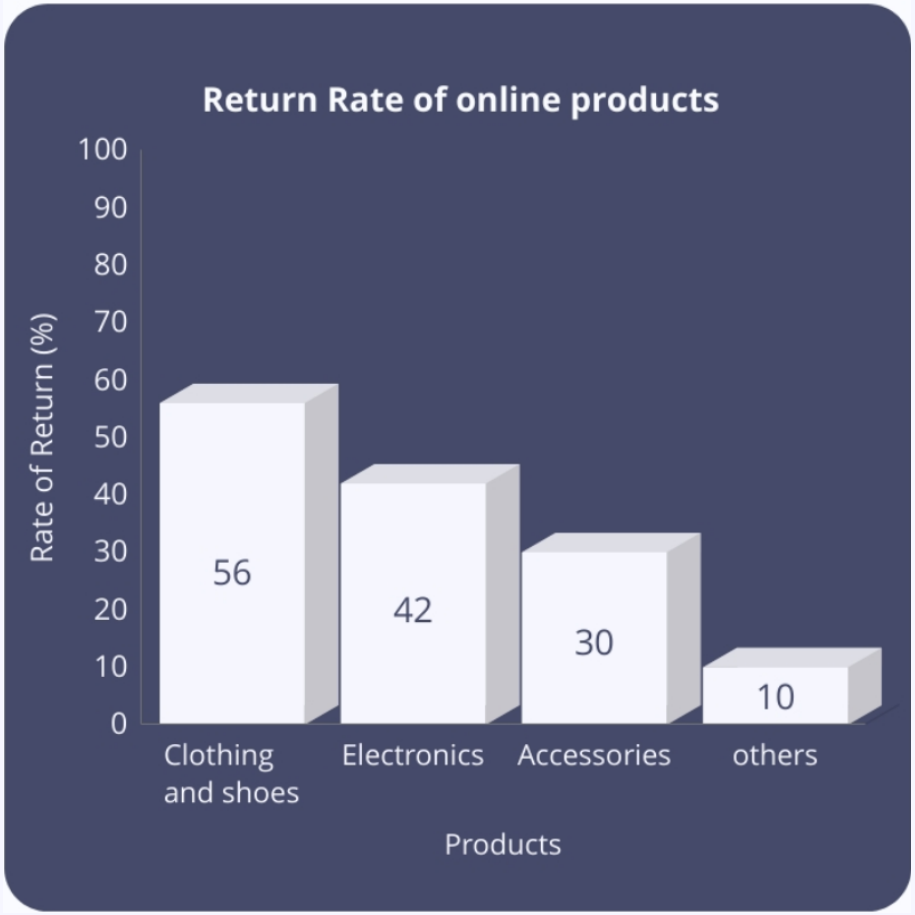
Guide name:
Mr. Kushal Kumar B N
Assistant Professor
Dept of CSE, KSIT

Team members:

Anusha A G	1KS17CS010
Deepika S H	1KS17CS022
Divya Yashaswi Kanney	1KS17CS023
H Priyanka	1KS17CS027

Introduction

- Following the SARS-CoV-2 disease (COVID-19) pandemic and nationwide lockdown, clothing which is essential for functional and social reasons became a discretionary need[1].
- The fashion industry has taken a hard hit. From the material to the spiritual, the supply chain to the ideological basis of its existence — every aspect of the industry is being wrung out to dry because of what's being called 'fashion's Darwinian shakeout'[2].
- Everyone, expectedly, is manufacturing masks, partly so their business gets to stay open as an 'essential service'. But masks are a controversial 'contribution' to the situation, given that it isn't really about how masks look but how they work that's important[2].



- Online shopping for clothing is doable but is unreliable for various reasons long before pandemic hit our streets.
- The top three online product categories doomed to be returned are, unsurprisingly, clothing and shoes (56%) followed by electronics (42%) and accessories/watches/jewelry (30%). 52% customers return their purchased items because the size/fit wasn't right or they can't try them on[3].
- Presenting "Virtual 3D trial room", an application which uses CNN to produce a 3D model of a person and allows them to try on clothes virtually.
- Based on the parameters taken from a single monocular video provided by the user as input, the 3D model is constructed which comprises the person-specific static geometry of the body, hair and clothing, alongside a coherent surface texture which is replaced by size-sensitive clothes subjected to trial[4].

Literature Survey

- Thiemo Alldieck et al. [4] describes a method to obtain accurate 3D body models and texture of arbitrary people from a single, monocular video in which a person is moving. Based on a parametric body model, the paper presents a robust processing pipeline to infer 3D model shapes including clothed people with 4.5mm reconstruction accuracy. The approach used is the transformation of dynamic body pose into a canonical frame of reference. This is done using only an RGB camera. There are three steps involved in this method:
  1) pose reconstruction
  2) consensus shape estimation
  3) frame refinement and texture map generation.

- Thiemo Alldieck et al. [5] describes a learning-based model, referred to as Octopus model to infer the personalized 3D shape of people from a few frames (1-8) of a monocular video in which the person is moving with a reconstruction accuracy of 4 to 5mm, while being orders of magnitude faster than previous methods. From semantic segmentation images, Octopus model reconstructs a 3D shape, including the parameters of SMPL plus clothing and hair in 10 seconds or less. The model achieves fast and accurate predictions based on two key design choices. First, by predicting shape in a canonical T-pose space, the network learns to encode the images of the person into pose invariant latent codes, where the information is fused. Second, based on the observation that feed-forward predictions are fast but do not always align with the input images, it predicts using both, bottom-up and top-down streams (hybrid method) allowing information to flow in both directions. Learning relies only on synthetic 3D data. Once learned, Octopus can take a variable number of frames as input, and is able to reconstruct shapes even from a single image with an accuracy of 5mm.

Literature Survey

- B. Bhatnagar et al. [6] describes a method to predict body shape and clothing, layered on top of the SMPL model from a few frames of a video. This model allows to predict garment geometry, relate it to the body shape, and transfer it to new body shapes and poses. The following steps are involved in this process:
  1) SMPL registration to the scans: For every scan, the underlying body shape, and the garments of the person registered to one of the 5 garment template categories: shirt, t-shirt, coat, short-pants, long-pants.
  2) Body aware scan segmentation: The garment templates are defined as regions on the SMPL surface; the original shape follows a human body, but it deforms to fit each of the scan instances after registration. Since garment registrations are naturally associated to the body represented with SMPL, they can be easily reposed to arbitrary poses.
  3) Template registration: Obtained data is used to train Multi-Garment Network to estimate the body shape and garments from one or more images of a person.

Problem Statement

"Due to the pandemic, everyone has taken to shopping online for their essentials. These essentials include clothing, and going outside to buy clothes hinders the social distancing health measure. Shopping online for clothes is difficult as there is no way to check the fitting and comfort of the clothes. Hence, a virtual 3D trial room allowing the user to upload a video of themselves along with few other inputs such as height and weight resulting in a robust, texture-rich 3D human model with clothes tried on would be helpful."

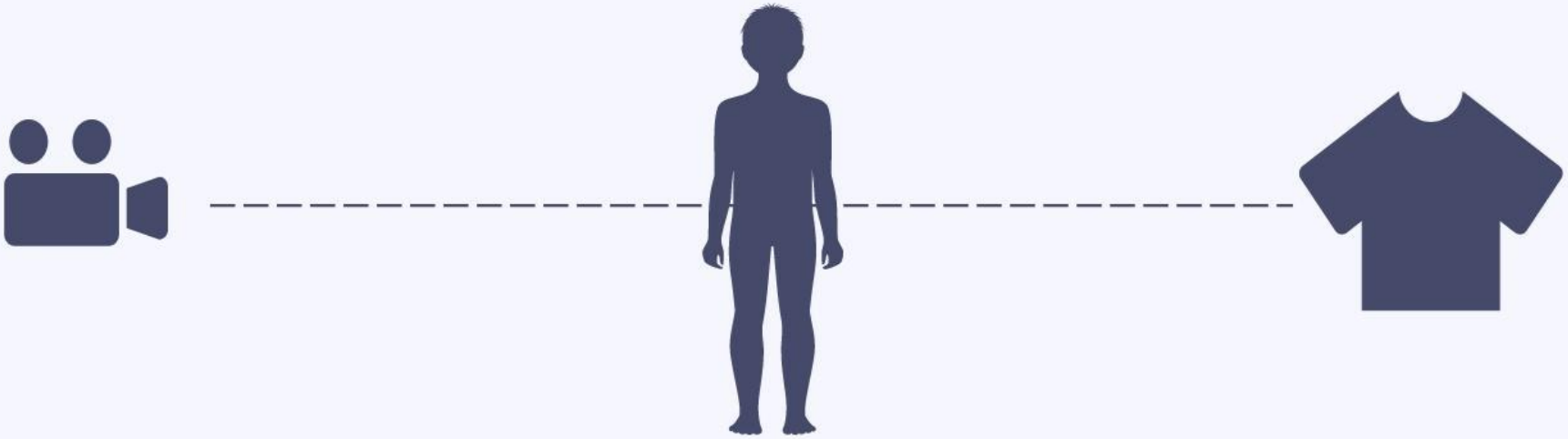
Methodology

The system has 2 main functionalities.
1] To reconstruct a 3D model[11] of the user from the input video.
2] Dress any body shape in arbitrary poses using the available 3D digital wardrobe.

The 3D model creation has three stages:
First, it analyses the video for a few seconds long of someone moving with T-pose, preferably turning 360°- to show all sides and for each frame creates a silhouette[9] separating the person from the background. Based on machine learning techniques in which computers learn a task from many examples it roughly estimates the 3D body shape and location of joints using SMPL[7] with clothes.
In the second stage, it combines information about the T-posed people into one, more accurate model from the obtained visual hulls.
Finally, in the third stage, it applies colour and texture to the model based on recorded hair, clothing, and skin[8].
In the next step, the 3D model is analysed to separate and extract the underlying body geometry, motion component and the clothing as separate geometric layers[10].

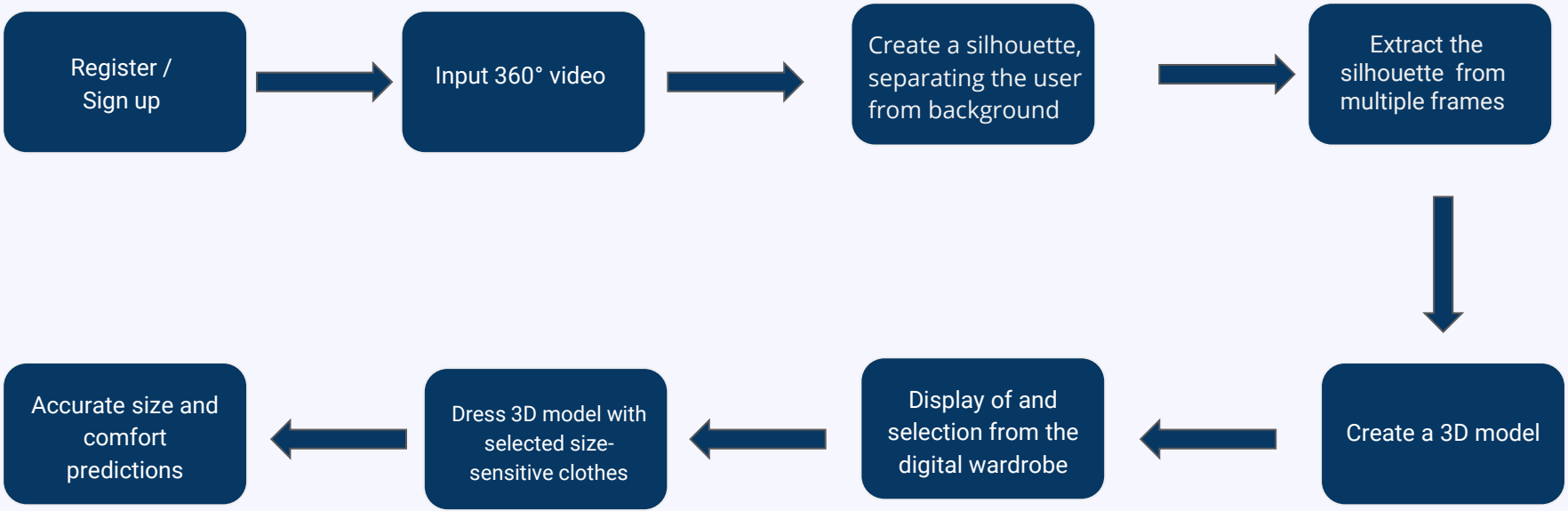
Methodology

The study of MGN model is used to replace the clothing geometry over the body geometry to “dress” any body shape in arbitrary poses. A publicly available digital wardrobe, the MGN model [6], and code is used to dress SMPL obtained 3D models with the garments.



- Uploading a video of the user rotating 360° horizontally
- Converting the video into a 3D human model
- Trying on the different clothes virtually with size-sensitivity

Overview of Workflow



Project Goals

- The main goal is to construct a website which succumbs the ill effects of the pandemic over real-life shopping by letting users purchase clothes which fit well while shopping online.
- To predict an accurate clothing geometry over the 3D human model.
- To diminish the enormous return rate of clothes and shoes on online retail websites.
- To simulate the trial of those specific clothes which aren't allowed to try offline as well.
- To improve user interaction and user experience during online shopping of clothes.

Expected Outcomes

- An application which creates 3D model of a person with utmost accuracy having proper hair and body geometry.
- After this, it lets them try on clothes virtually from the digital wardrobe that is already present in the website. Hence providing the user with a better shopping experience.

Contribution to Society

- Virtual 3D trial room can be implemented in the already existing online clothing websites such as Amazon, Myntra and Ajio to improve user experience.
- This can also be used in malls and other fashion outlets in the form of virtual mirror which will subsequently make the entire shopping a lucrative business with better customer recall and retention, thereby increasing sales.
- With the implementation of the virtual trial mirrors in shops the damage caused by trying on clothes in the offline trial rooms gets reduced.
- Encouraging public health measures such as quarantine and social distancing.
- To support the small to medium fashion businesses that rely heavily on offline purchases.

References

[1] Prachi Gupta, “Coronavirus changes meaning of essentials; hygiene items important; clothing, beauty take backseat,” *financialexpress.com*, para. 1, Apr. 22, 2020. [Online]. Available: https://www.financialexpress.com/industry/coronavirus-changes-meaning-of-essentials-hygiene-items-important-clothing-beauty-take-backseat/1936330/.

[2] Manjima Bhattacharjya, “For global fashion industry, impact of coronavirus pandemic presents both crisis — and opportunity to recast itself,” *firstpost.com*, Jun. 21, 2020. [Online]. Available: https://www.firstpost.com/living/for-global-fashion-industry-impact-of-coronavirus-pandemic-presents-both-crisis-and-opportunity-to-recast-itself-8493781.html.

[3] Katie Gilsenan, “Online Shopping Returns: Everything Retailers Need to Know,”, *globalwebindex.com*, Dec. 3, 2018. [Online]. Available: https://blog.globalwebindex.com/chart-of-the-week/online-shopping-returns/.

[4] T. Alldieck, M. Magnor, W. Xu, C. Theobalt and G. Pons-Moll, "Video Based Reconstruction of 3D People Models," 2018 IEEE/CVF Conference on Computer Vision and Pattern Recognition, Salt Lake City, UT, 2018, pp. 8387-8397, doi: 10.1109/CVPR.2018.00875.

[5] Thiemo Alldieck, Marcus Magnor, Bharat Lal Bhatnagar, Christian Theobalt, Gerard PonsMoll "Learning to Reconstruct People in Clothing from a Single RGB Camera", 2019 IEEE Conference on Computer Vision and Pattern Recognition, Germany.

[6] B. Bhatnagar, G. Tiwari, C. Theobalt and G. Pons-Moll, "Multi-Garment Net: Learning to Dress 3D People From Images," 2019 IEEE/CVF International Conference on Computer Vision (ICCV), Seoul, Korea (South), 2019, pp. 5419-5429, doi: 10.1109/ICCV.2019.00552.

[7] Federica Bogo, Angjoo Kanazawa, Christoph Lassner, Peter Gehler, Javier Romero, and Michael J Black. "Keep it SMPL: Automatic estimation of 3D human pose and shape from a single image." In European Conf. on Computer Vision. Springer International Publishing, 2016.

[8] Matthew Hutson, "Watch artificial intelligence create a 3D model of a person—from just a few seconds of video", AAAS Journal Apr. 3,2018. [Online]. Available: https://www.sciencemag.org/news/2018/04/watch-artificial-intelligence-create-3d-model-person-just-few-seconds-video.

[9] A. Laurentini, "The visual hull concept for silhouette-based image understanding," in IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 16, no. 2, pp. 150-162, Feb. 1994, doi: 10.1109/34.273735.

[10] Balan, Alexandru & Black, Michael. (2008). The Naked Truth: Estimating Body Shape Under Clothing. 15-29. 10.1007/978-3-540-88688-4_2.

[11] '3D reconstruction' (2020) Wikipedia. Available at: https://en.wikipedia.org/wiki/3D_reconstruction#:~:text=In%20computer%20vision%20and%20computer,rigid%20or%20spatio%2Dtemporal%20reconstruction.

Thank You