MPhil / Part III Projects

My group focuses on machine vision, computer graphics, and machine learning/artificial intelligence. We work with image/video and 3D data. Below you will find example projects but we have many more. We can discuss possible projects so that you can decide based on your interests and skills.

In general, I am looking for students that have curiosity and excitement, strong programming skills at least in Python, and some knowledge of visual data processing.

You may find some project examples below. Again, these are only examples and we can discuss many others.

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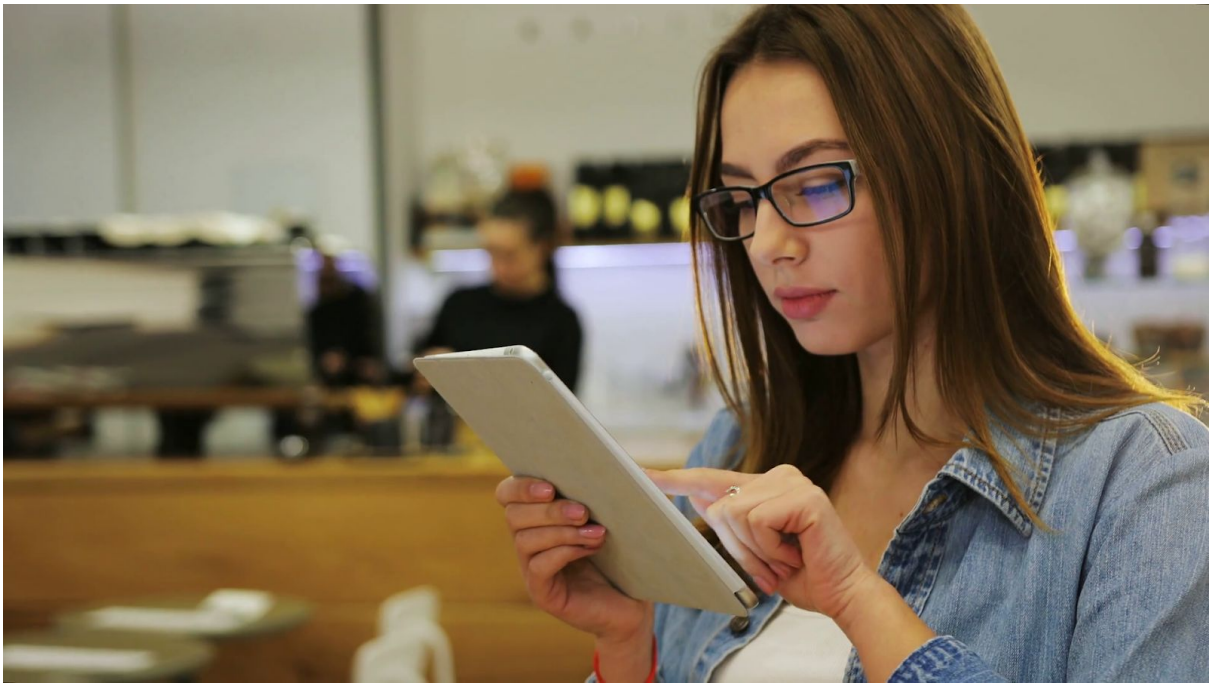
Every screen is a touch screen with smart glasses

MPhil / Part III Project



Introduction

High precision real-time hand tracking is one of the most difficult problems to solve to realize interactive human-computer interfaces. We will consider a particular and practical setting where the user is wearing smart glasses or any device with a camera integrated. In this case, the camera can see the screen and the user's hand and hence can do reliable background subtraction, segmentation, and pose estimation for the fingers. We can then use this to turn the screen into a touch screen as we know where the hand and fingers are on the screen.

Tasks

- Implement an API for smart glass-computer communication in real-time
- Use camera calibration and background subtraction for hand segmentation
- Design and implement finger segmentation, location estimation, gesture recognition

Skills

- Curiosity and creativity
- Good programming skills in Python and possibly C++
- Knowledge of hand tracking is a plus

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Neural Face Super-resolution for Low Bandwidth Teleconferencing

MPhil / Part III Project

Introduction

Super-resolution refers to increasing the resolution of, i.e. the number pixels in, images and video by synthesizing details that can be represented at the target resolution. This is a hard inverse problem: for a given low resolution image, there are infinitely many possible output images. We will tackle this problem for the specific case of human faces. We will develop a part-based model and apply a different neural up-sampler for each part (eyes, skin, nose, mouth) separately.

Tasks

- Collect/download a dataset of face images
- Run a segmentation algorithm to extract eyes, skin, nose, and mouth
- Train a neural network for each part for super-resolution
- Align super-resolved parts to generate the output image

Skills

- Curiosity and creativity
- Good programming skills in Python and possibly C++
- Familiarity with TensorFlow or PyTorch is a plus

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A Magic Mirror with Augmented Reality for Virtual Try-on

MPhil / Part III Project

Introduction

Online retail is still lacking immersive shopping experiences. There have been notable efforts by e.g. the furniture industry for introducing 3D and augmented reality technologies but with limited success so far. We consider a carefully designed scenario to aid the algorithms: an individual standing in front of a mirror and wearing smart glasses changes the color and reflection properties of the shirt she/he is wearing.

Tasks

- Implement a shirt segmentation algorithm for an image in the mirror
- Change and render the material of the shirt based on a material model
- Augment and display the rendered shirt in real-time for the smart glass

Skills

- Curiosity and creativity
- Good programming skills in Python and possibly C++

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Plant Image Synthesis with Neural Generative Models

MPhil / Part III Project

Introduction

Generative approaches have been proven successful in synthesizing images of objects such as human faces, thanks to the availability of datasets and fine-tuned algorithms. However, although there are numerous important applications in agriculture, they have not been used to synthesize plant images so far. In collaboration with the agritech industry, we will develop the first system and algorithms to synthesize plant images to be used for plant classification in this project.

Tasks

- Organize the captured plant image data from real fields
- Design a generative model with neural networks
- Experiment with different configurations for realistic plant image synthesis
- Use the generated images within a standard classification algorithm

Skills

- Curiosity and creativity
- Good programming skills in Python and possibly C++
- Familiarity with TensorFlow or PyTorch and generative networks is a plus

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Patch Space
Neural Image Processing

MPhil / Part III Project

Introduction

Image processing for enhancing and stylizing images has evolved over the last decades from color space based methods to neural network based methods. Although color space transformations are restrictive, they are robust and used in all modern image processing libraries. Neural methods have more expressive power but are unpredictable in terms of quality. In this project, we will propose a completely new paradigm: patch space neural image processing that combines advantages of both ends.

Tasks

- Design a framework to extract, process, and assemble image patches
- Develop a theory of patch space linear transformations with constraints
- Experiment with pixel colors and higher level (e.g. VGG) features
- Implement interactive image processing interfaces for patch space transforms

Skills

- Curiosity and creativity
- Good programming skills in Python and possibly C++
- Familiarity with TensorFlow or PyTorch is a plus

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