CMP9135M - Computer Vision – Lecture 1: “Introduction”

Dr Wenting Duan – Research areas:

* Currently researching medical image analysis
* AI applied Agri technology and to help sorting out environment pollution

Assessment

* One Assignment - 100% THEORETICAL AND PRACTICAL
* Main software being used is MATLAB but OpenCV is also acceptable

Topics

* Image formation, camera
* Image segmentation
* Feature detection/matching
* Texture analysis
* Dimensional reduction techniques
* Visual tracking
* Object detection/recognition – deep learning
* Active vision
* Image registration and reconstruction
* Applications (medical imaging, surveillance, research applied, e.t.c.)

Recommended reading:

Why computer Vision?

Images and videos are everywhere, Neural networks or advanced processing techniques are needed to process all this data and extract meaningful information.

Computer vision is a fast-growing collection of useful applications. From Surveillance, Medical environment, Entertainment and Safety, etc.

Vision Based Biometrics – Iris detection can be a very accurate way to identify people.

Amazon Go – using computer vision to improve autonomous retail

Space exploration – NASA’S mars exploration rover spirit captured this westward view from atop a low plateau where Spirit spent the closing months of 2007.

Removing debris from space – calculating the distance and force to use to enabling the grappling of debris and directing them to be burned in space.

Medicine and Healthcare – identifying diseases with computer vision

Effective radiotherapy research at Lincoln University that allows proton-therapy to use something called a peak to direct peak energy to the right location during surgery and eliminate tumours with reduced damage to surrounding areas.

Example – Lincoln Research

What is computer vision?

The science and technology of machines that see.

Fundamental challenges

3D to 2D implies information loss

Geometric changes – surface slant depends on viewpoint

Human Vision

Vision is an amazing feature of natural intelligence

A larger percentage of the human brain is devoted to vision than anything else.

Recognising objects and people

Locate objects in space

Track objects in motion

Recognise actions

But humans can also tell a lot about a scene from a little information.

Humans see effortlessly (low power consumption) and immediately (i.e. real-time performance).

Illusion Examples

Cup or two faces

A black and white grid

A mix of ladders that looks 3d and 2d at times

Image Acquisition

Pre-Processing

Aim: an improvement of the image data that supresses unwanted distortion or enhance some image features important for further processing.

Image enhancement

* Adjust contrast, remote noise, sharpen details

Format conversion

* e.g. from RGB to HSV colour space

Filtering

* e.g. remove small objects, fill in holes, etc.

Segmentation

Segment relevant image regions

e.g. foreground/ background detection

e.g. Skin colour filtering

Based on some basic

Representation / Description

Representation: two choices, in terms of:

External characteristics (boundary)

Internal characteristics (pixels compromising the colour)

Digital Image Acquisition

Single image sensor – captures a single point (pixel) of information at a time.

Line sensor – captures data line by line

Array sensor – 2D Like a board

Acquisition techniques

The energy from an illumination source is reflected and absorbed by the imaging system.

Sampling and Quantization

Digital image can be seen as a 2D function f (X, Y)

X and Y are the spatial coordinates

Sampling

Quantisation

Quantisation corresponds to a discretization of the intensity values. That is, of the co-domain of the function.

Interpolation techniques

Nearest neighbour

Bilinear interpolation – Used weighted averages of 4 neighbouring pixels, The weight depends on a relative distance between pixels in the grids.

Difference between nearest neighbour and linear, Bilinear creates a smoother image that sometimes makes features more able to be detected. It depends on the image as Bilinear is not always better, sometimes Nearest Neighbour creates an image with much clearer features.

Bicubic

Basic