Summer Research Project
Video Based Mouse Seizure Detection

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Content

- A few concepts in image processing and computer vision:
  - a few morphological operations
- Results of the week
  - Filtering Flow by connectivity
  - Hand writing line detection criteria

Background Concepts: Morphological Transformation

Definition

Morphological Transformations are simple transformations based on shape. They're usually performed on a binary input and require the definition of a **structuring element**, which decides the extent and nature of the operation.

- they're usually used to enhance some property of the image or to reduce noise.
- Morphological transformations are one of the techniques broadly used during this work.
- They can be seen as the **generalized convolution** where a window is slided through the image and some operation is realized at each pixel.

Morphological Transformation: Erosion

Definition

The kernel is a matrix filled with ones and zeros. One means we care about the pixel position and zero means don't cares. Center the kernel at the pixel to be evaluated. If the all the positions marked as ones in the kernel are also ones in the image, the center pixel is one, otherwise it is zero.

- The kernel is usually a small matrix filled with ones.
- It can also be a square matrix where the ones in it approximate an ellipse
- This operation will reduce the area of the foreground. If the foreground was initially noise and had small area, it will disappear.

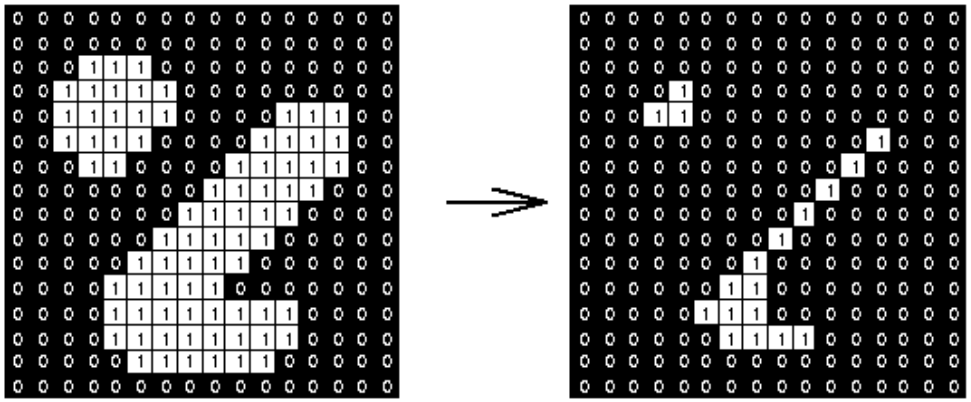

Figure : Effect of erosion with a 3x3 kernel. [1]

[1] from http://homepages.inf.ed.ac.uk/rbf/HIPR2/erode.htm

Morphological Transformation: Dilation

Definition

Similar to Erosion, but here the center pixel is set to one if at least one of the values in the image is one where the kernel is also one.

- You can see erosion as an **and** between the kernel and the window and dilation as an **or**.(remember there are don't cares in the kernel)
- This will increase the area of what is considered foreground. Suppose there are holes in the foreground, it will likely close them with enough operations.
- It will also enhance are of the noise signal. That's why we usually apply it followed by an erosion. This combination is called closing operation. The opposite order is called opening.

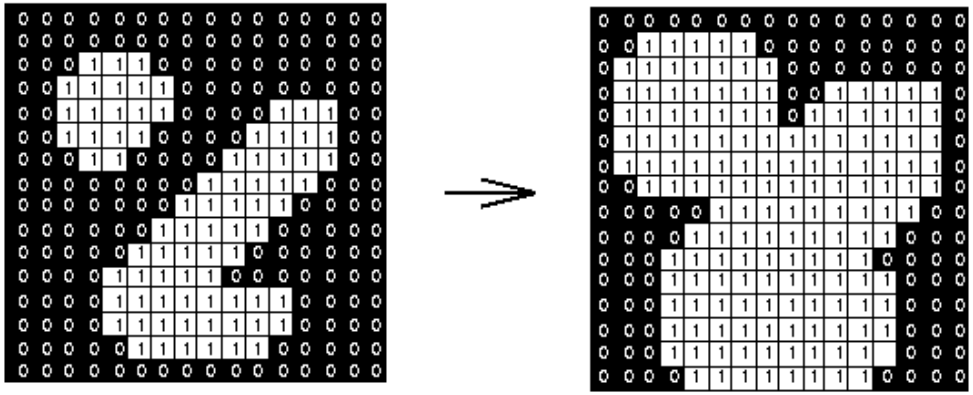

Figure : Effect of dilation with a 3x3 kernel [2]

[2] from http://homepages.inf.ed.ac.uk/rbf/HIPR2/dilate.htm

Results of the Week: Filtering Flow by Connectivity

Motivation

Spurious optical flow differs from true movement flow in connectivity. Noisy flow is likely to occur on isolated points.

- Connectivity is a term that remember us of graph theory and definitely some graph package could be used for this task
- However, there is an image processing trick that will do the job:
  - Create a grid of zeros with the size of the image and fill with ones where the optical flow has magnitude in a certain range.
  - In case the flow is computed in sparse points, apply a closing operation to connect near points
  - Look now for contours and keep only those with value of area in a certain range

Results of the Week: Filtering Flow by Connectivity

- Finally, keep only flow vectors on positions that lie inside one of the valid contours
- The only problem is that in the processes of closing we might increase the strength of a spurious signal. Setting the thresholds properly should solve this problem.
- Run demo on camera

Results of the Week: Detecting Mouse in a Line

- A few week ago I suggested that neural networks would be able to detect a mouse in a line of pixels by being able to distinguish between its texture and the background texture
- Still, the neural network wasn't able to learn the features; maybe for a bug in implementation, maybe for lack of layers and nodes
- But what if we're able to right down the features we wanted the neural net to learn?

Detecting Mouse in a Line: details

- Fix a window of length L around one pixel
- If L is not too big, on a plain surface the values within the window should be similar
- On a shiny or noisy surface, the value inside the window will vary a lot
- The variance is a good measure of how much dispersion theres is in a set.
- Run demo of detection