LAB 5 ACTIVE CONTOURS

ECE 6310 Intro to Computer Vision

Mohammad Anas Imam Khan

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This report talks about how the active contour algorithm was realized on a grayscale image. The steps are mentioned below:

- **Sobel Gradient and External Energy**
  The Sobel gradient was found by convolving a kernel matrix of 3-by-3 size over the image. The matrices used for the horizontal and vertical filters are as shown. This gave the gradient along with horizontal and vertical directions. The final gradient was then computed as:

$$Sobel_{Gradient} = \sqrt{(Gradient_{hor})^2 + (Gradient_{ver})^2}$$

$$f_{hor} = \begin{matrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{matrix} \qquad f_{ver} = \begin{matrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{matrix}$$

  The values found from Sobel Gradient were normalized between 0 and 255 and the square of the normalized values was taken. These values were further normalized between 0 and 1 to give the external energy term. The external energy was calculated as shown. I is the intensity value.

$$E_{ext} = -I(x_i, y_i)$$

Figure 1 Original image

Figure 2 Sobel Image

The normalization is done using the formula:

$$Normalize = (I - \text{Minimum}) * \frac{\text{newMax} - \text{newMin}}{Maximum - Minimum} + newMin$$

- **Internal Energy 1**
  This was computed by drawing a window of 7*7 pixels around a contour point and then calculating the distance from that pixel to the next contour point. These values were also normalized between 0 and 1.

$$IE_1 = \left(x_{i_i} - x_{i+1}\right)^2 + \left(y_{i_i} - y_{i+1}\right)^2$$

- **Internal Energy 2**
  First, the average distance of each pixel in the 7*7 window across all the points was computed from the first term. This value was subtracted from the IE_1 term to give the second internal energy.

$$AVG_{dist} = \sum_{i=0}^{tot\_points} IE_1$$

$$IE_2 = AVG_{dist} - IE_1$$

- **Total Energy**
  The total energy was calculated for **30 iterations** for a **window size of 7.** The contour points were moved in the direction where the total energy was minimum across the 7*7 window. The weights of each of the energy terms had to be tuned to get the ideal contour around the hawk.

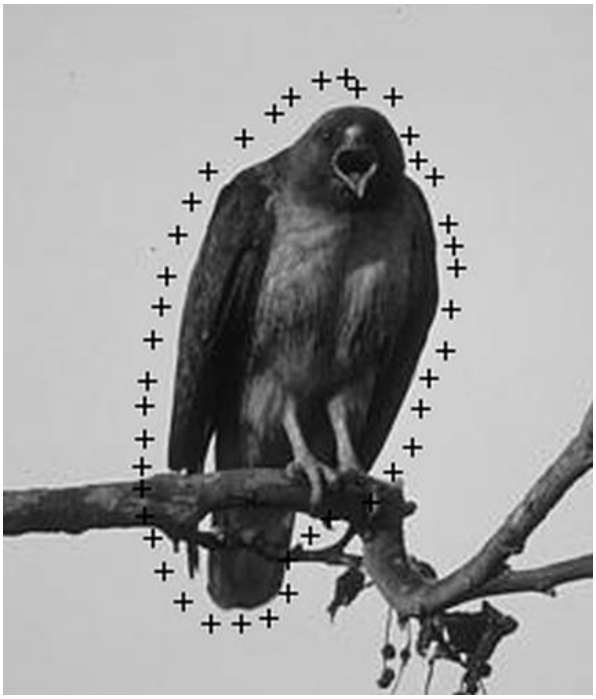

Figure 3 Initial Contours

For equal weights across all the energy terms, the contour came out to be:

Figure 4 Contour with Equally Weighted Energy

Internal Energy 1 Weight = 1.085 | Internal Energy 2 Weight = 1.16 | External Energy Weight = 0.13

Figure 5 Weighted Energy

The final list of contour points was:

Column	Row
279	159
275	169
271	180
268	188
265	195
261	205
255	216
246	228
235	234
227	235
223	246
223	258
214	266
206	266
197	263
196	254
196	247
191	241
181	233
181	220
182	208
183	195
184	183
185	171
187	160
189	149
193	136
197	125
200	116
212	106
219	103
228	97
240	86
249	84
258	87
264	94
267	105
273	114
276	122
278	131
279	140
279	150

278	131
279	140
279	150