LAB 5 ACTIVE CONTOURS

ECE 6310 Intro to Computer Vision

Mohammad Anas Imam Khan C17566828 October 27,2020

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:

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

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

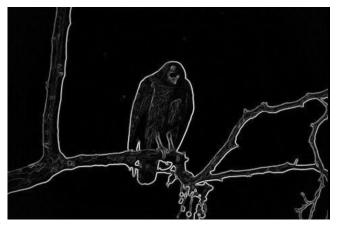


Figure 2 Sobel Image

The normalization is done using the formula:

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

• 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.

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

• 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:

279 159 275 169 271 180 268 188 265 195 261 205 255 216 246 228 235 234 227 235 223 246 223 258 214 266 206 266 197 263 196 247 191 241 181 233 182 208 183 195 184 183 185 171 187 160 189 149 193 136 197 125 200 116 212 106 219 103 228 97 240 86 249 84 258 87 264 94 267 105 273 114 <th>Column</th> <th>Row</th>	Column	Row
275 169 271 180 268 188 265 195 261 205 255 216 246 228 235 234 227 235 223 246 223 258 214 266 206 266 197 263 196 247 191 241 181 233 182 208 183 195 184 183 185 171 187 160 189 149 193 136 197 125 200 116 212 106 219 103 228 97 240 86 249 84 258 87 264 94 267 105 273 114 276 122 <td></td> <td></td>		
271 180 268 188 261 205 255 216 246 228 235 234 227 235 223 246 223 258 214 266 206 266 197 263 196 247 191 241 181 233 182 208 183 195 184 183 185 171 187 160 189 149 193 136 197 125 200 116 212 106 219 103 228 97 240 86 249 84 258 87 264 94 267 105 273 114 276 122 278 131 279 140 <td></td> <td></td>		
268 188 265 195 261 205 255 216 246 228 235 234 227 235 223 246 223 258 214 266 206 266 197 263 196 247 191 241 181 233 182 208 183 195 184 183 185 171 187 160 189 149 193 136 197 125 200 116 212 106 219 103 228 97 240 86 249 84 258 87 264 94 267 105 273 114 276 122 278 131 279 140 <td></td> <td></td>		
265 195 261 205 255 216 246 228 235 234 227 235 223 246 223 258 214 266 206 266 197 263 196 247 191 241 181 233 182 208 183 195 184 183 185 171 187 160 189 149 193 136 197 125 200 116 212 106 219 103 228 97 240 86 249 84 258 87 264 94 267 105 273 114 276 122 278 131 279 140		
261 205 255 216 246 228 235 234 227 235 223 246 223 258 214 266 206 266 197 263 196 247 191 241 181 233 182 208 183 195 184 183 185 171 187 160 189 149 193 136 197 125 200 116 212 106 219 103 228 97 240 86 249 84 258 87 264 94 267 105 273 114 276 122 278 131 279 140		
255 216 246 228 235 234 227 235 223 246 223 258 214 266 206 266 197 263 196 247 191 241 181 233 182 208 183 195 184 183 185 171 187 160 189 149 193 136 197 125 200 116 212 106 219 103 228 97 240 86 249 84 258 87 264 94 267 105 273 114 276 122 278 131 279 140		
246 228 235 234 227 235 223 246 223 258 214 266 206 266 197 263 196 247 191 241 181 233 182 208 183 195 184 183 185 171 187 160 189 149 193 136 197 125 200 116 212 106 219 103 228 97 240 86 249 84 258 87 264 94 267 105 273 114 276 122 278 131 279 140		
235 234 227 235 223 246 223 258 214 266 206 266 197 263 196 254 191 241 181 233 182 208 183 195 184 183 185 171 187 160 189 149 193 136 197 125 200 116 212 106 219 103 228 97 240 86 249 84 258 87 264 94 267 105 273 114 276 122 278 131 279 140		
227 235 223 246 223 258 214 266 206 266 197 263 196 254 196 247 191 241 181 233 182 208 183 195 184 183 185 171 187 160 189 149 193 136 197 125 200 116 212 106 219 103 228 97 240 86 249 84 258 87 264 94 267 105 273 114 276 122 278 131 279 140		
223 246 223 258 214 266 206 266 197 263 196 254 199 241 181 233 182 208 183 195 184 183 185 171 187 160 189 149 193 136 197 125 200 116 212 106 219 103 228 97 240 86 249 84 258 87 264 94 267 105 273 114 276 122 278 131 279 140		
223 258 214 266 206 266 197 263 196 254 196 247 191 241 181 233 182 208 183 195 184 183 185 171 187 160 189 149 193 136 197 125 200 116 212 106 219 103 228 97 240 86 249 84 258 87 264 94 267 105 273 114 276 122 278 131 279 140		
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		
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		
197 263 196 254 191 241 181 233 181 220 182 208 183 195 184 183 185 171 187 160 189 149 193 136 197 125 200 116 212 106 219 103 228 97 240 86 249 84 258 87 264 94 267 105 273 114 276 122 278 131 279 140		
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		
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		
191 241 181 233 182 208 183 195 184 183 185 171 187 160 189 149 193 136 197 125 200 116 212 106 219 103 228 97 240 86 249 84 258 87 264 94 267 105 273 114 276 122 278 131 279 140		
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		
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	181	
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	181	220
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	182	
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	183	195
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	184	183
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	185	171
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	187	160
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	189	149
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	193	136
212 106 219 103 228 97 240 86 249 84 258 87 264 94 267 105 273 114 276 122 278 131 279 140	197	125
219 103 228 97 240 86 249 84 258 87 264 94 267 105 273 114 276 122 278 131 279 140	200	116
228 97 240 86 249 84 258 87 264 94 267 105 273 114 276 122 278 131 279 140	212	106
240 86 249 84 258 87 264 94 267 105 273 114 276 122 278 131 279 140	219	103
249 84 258 87 264 94 267 105 273 114 276 122 278 131 279 140	228	97
258 87 264 94 267 105 273 114 276 122 278 131 279 140	240	86
264 94 267 105 273 114 276 122 278 131 279 140	249	84
267 105 273 114 276 122 278 131 279 140	258	87
273 114 276 122 278 131 279 140	264	94
276 122 278 131 279 140	267	105
278 131 279 140	273	114
279 140	276	122
	278	131
279 150	279	140
= 0	279	150

278	131
279	140
279	150