Image Processing

Dhruv Garg
16BCE1190

DIGITAL ASSIGNMENT-1

Q1 Consider the two image subsets S_1 and S_2, shown in the figure. For $V = \{1\}$, determine whether the two subsets are (a) 4-adjacent, (b) 8-adjacent, or (c) m-adjacent.

	S_1				S_2				
0	0	0	0	0	0	0	1	1	0
1	0	0	1	0	0	1	0	0	1
1	0	0	1	0	1	1	0	0	0
0	0	1	1	1	0	0	0	0	0
0	0	1	1	1	0	0	1	1	1

Ans: THEORY:

"V" is the set of gray levels used to define connectivity for two points $p, q \in V$.

3 types of connectivity are defined as follows:

(A) 4-connectivity $\Rightarrow$ $p, q \in V$ and $p \in N_4(q)$

(B) 8-connectivity $\Rightarrow$ $p, q \in V$ and $p \in N_8(q)$

(C) M-connectivity (mixed connectivity) $\Rightarrow$

(i) $q \in N_4(p)$ or

(ii) $q \in N_D(p)$ and $N_4(p) \cap N_4(q) = \emptyset$

Two pixels: p & q are adjacent if they are connected by 4/8/m-adjacency.

$\therefore$ $\boxed{\text{Two image subsets } S_i \text{ and } S_j \text{ are adjacent if } \exists\, p \in S_i \text{ and } \exists\, q \in S_j \text{ such that } p \text{ and } q \text{ are adjacent.}}$

SOLUTION :

Let "p" and "q" be two pixels from the subsets S_1 and S_2.

	S_1				S_2				
0	0	0	0	0	0	0	1	1	0
1	0	0	1	0	0	1	0	0	1
1	0	0	1	0	1 q	1	0	0	0
0	0	1	1	p 1	0	0	0	0	0
0	0	1	1	1	0	0	1	1	1

(a) S_1 and S_2 are not 4-connected because "q" is not in the set $N_4(p)$.

(b) S_1 and S_2 are 8-connected because "q" is present in the set $N_8(p)$.

(c) S_1 and S_2 are m-connected because (i) q is in $N_D(p)$ and (ii) the set $N_4(p)$ and its intersection with $N_4(q)$ is empty. i.e. $N_4(p) \cap N_4(q) = \emptyset$

Q2 Consider the image segment as shown:

(a) Let $V = \{0, 1\}$ and compute the lengths of the shortest 4-, 8- and m-path between p and q. If a particular path does not exist between these two points, explain why.

(b) Repeat for: $V = \{1, 2\}$

	3	1	2	1 (q)
	2	2	0	2
	1	2	1	1
(p)	1	0	1	2

Dhruv Garg
16BCE1190

Ans: THEORY:

A path from $p(x,y)$ to $q(s,t)$ is a sequence of distinct pixels.

$(x_0, y_0), (x_1, y_1), \ldots\ldots (x_n, y_n)$

where $(x_0, y_0) = \underbrace{(x,y)}_{p}, \quad (x_n, y_n) = \underbrace{(s,t)}_{q}$

Such that (x_i, y_i) is adjacent to (x_{i-1}, y_{i-1}) for $1 \leq i \leq n$ where "n" is the length of the path.

Part (a): when $V = \{0, 1\}$

4-path: A 4-path does not exist between "p" and "q" by traveling along the points that are both 4-adjacent and also have values from V. The figure shows that it is not possible to get to q.

	3	1	2	1 (q)
	2	2	0 → ~~2~~	2
	1	2	1	1
(p)	1 →	0 →	1	2

8-path: The shortest 8-path is of length 4.

	3	1	2	1 (q)
	2	2	0	2
	1	2	1	1
(p)	1 →	0	1	2

m-path: The shortest m-path length is 5.

	3	1	2	1 (q)
	2	2	0	2
	1	2	1	1
(p)	1 →	0 →	1	2

Part (b) : When $V = \{1, 2\}$

4-path

There are multiple 4-paths available. The shortest is of length 6. For length 6 as well there are multiple paths. One of them is shown.

	3	1	2	1 (q)
	2	2	0	2
	1	2	1	1
(p)	1	0	1	2

8-path

For shortest 8-path, its length is 4. However it is not unique .ie. there are multiple 8-paths with length 4.

	3	1	2	1 (q)
	2	2	0	2
	1	2	1	1
(p)	1	0	1	2

m-path

The shortest m-path is of length 6. There are multiple m-paths with length 6. One of them is shown below.

	3	1	2	1 (q)
	2	2	0	2
	1	2	1	1
(p)	1	0	1	2