$$v(x,y) = \sum_{i=0}^{3} \sum_{j=0}^{3} a_{ij}\, x^i y^j$$

$$\therefore v(x,y) = a_{00} + a_{01} y^1 + a_{02} y^2 + a_{03} y^3$$

$$+ a_{10} x + a_{11} x^1 y^1 + a_{12} x^1 y^2 + a_{13} x^1 y^3$$

$$+ a_{20} x^2 + a_{21} x^2 y^1 + a_{22} x^2 y^2 + a_{23} x^2 y^3$$

$$+ a_{30} x^3 + a_{31} x^3 y^1 + a_{32} x^3 y^2 + a_{33} x^3 y^3$$

$$\therefore v(x,y) = \begin{bmatrix} 1 & x & x^2 & x^3 \end{bmatrix} \begin{bmatrix} a_{00} & a_{01} & \cdots & a_{03} \\ & \vdots & & \\ a_{30} & a_{31} & a_{32} & a_{33} \end{bmatrix} \begin{bmatrix} 1 \\ y \\ y^2 \\ y^3 \end{bmatrix}$$

(Matrix representation)

$$\therefore \underset{\substack{\uparrow \\ I}}{v(x,y)} = \underset{\substack{\uparrow \\ A}}{\begin{bmatrix} 1 & y & y^2 & y^3 & x & x^1y^1 & \cdots & x^3y^1 & x^3y^2 & x^3y^3 \end{bmatrix}} \underset{\substack{\uparrow \\ B}}{\begin{bmatrix} a_{00} \\ a_{01} \\ \vdots \\ a_{33} \end{bmatrix}}$$

$\therefore$ for each pixel in the neighbourhood (16 neighbours) we get 1 equation each.

$\therefore$ 16 equations:

$$I_1 = A_1 B$$
$$I_2 = A_2 B$$
$$\vdots$$
$$I_{16} = A_{16} B$$

$$\therefore \underbrace{\begin{bmatrix} I_1 \\ I_2 \\ \vdots \\ I_{16} \end{bmatrix}}_{M} = \underbrace{\begin{bmatrix} 1 & y_1 & y_1^2 & \cdots & x_1^3 y_1^3 \\ 1 & y_2 & y_2^2 & \cdots & x_2^3 y_2^3 \\ & & \vdots & & \\ 1 & y_{16} & y_{16}^2 & \cdots & x_{16}^3 y_{16}^3 \end{bmatrix}}_{N} \underbrace{\begin{bmatrix} a_{00} \\ a_{01} \\ \vdots \\ a_{33} \end{bmatrix}}_{P}$$

$$M = NP$$

$$\boxed{P = N^{-1} M}$$

We require 16 neighbours because there are 16 unknowns $\therefore$ We use 16 equations