WORLDONE

2) Consider two images frame Captured at time 't' and '$t+\delta t$' respectively.

let a point $p(x, y)$ in image 1 displaced to $P(x+\delta x, y+\delta y)$ in image 2

Assuming the intensities of point 'P' doesnot change in both the images

$$I(x+\delta x, y+\delta y, t+\delta t) = I(x, y, t) \rightarrow (1)$$

From taylor Series expansion, we can rewrite this as

$$I(x+\delta x, y+\delta y, t+\delta t) = I(x, y, t) + \frac{\delta I}{\delta x}\delta x + \frac{\delta I}{\delta y}\delta y + \frac{\delta I}{\delta t}\delta t$$

$$I(x+\delta x, y+\delta y, t+\delta t) = I(x, y, t) + I_x\delta x + I_y\delta y + I_t\delta t \rightarrow (2)$$

Substract (1) from (2)

$$I_x\delta x + I_y\delta y + I_t\delta t = 0$$

divide by δt & take limit as $\delta t \to 0$

Equation $\boxed{I_x u + I_y v + I_t = 0}$

(u, v) : Optical flow

Considering two consecutive image frame and 2x2 block of pixels from each image

	Image 1 (t) k	Image 1 (t) $k+1$	Image 2 ($t+1$) k	Image 2 ($t+1$) $k+1$
$l+1$	64	57	53	83
l	108	105	112	99

y ↑ → x

(Image 1) (Image 2)

$$I_x = \frac{57+105+83+99}{4} - \frac{64+108+53+112}{4}$$

$$= 86 - 84.25 = 1.75$$

$$I_y = \frac{64+57+53+83}{4} - \frac{108+105+112+99}{4}$$

$$= 76 - 64.5 = 11.5$$

$$I_t = \frac{53+83+112+99}{4} - \frac{64+57+108+105}{4}$$

$$= 86.75 - 83.5 = 3.25$$

$l+1$	54	45		48	80	
l	100	98	(t)	108	90	$(t+1)$
	k	$k+1$		k	$k+1$	
	(Image 1)			(Image 2)		

y, x

$$I_x = \frac{54+98+90+80}{4} - \frac{54+100+48+108}{4}$$

$$= 80.5 - 77.5 = 3$$

$$I_y = \frac{54+45+48+80}{4} - \frac{100+98+108+90}{4}$$

$$= 56.75 - 99$$

$$= 42.25$$

$$I_t = \frac{54+45+108+98}{4} - \frac{48+80+90+108}{4}$$

$$= 81.5 - 74.25 \quad = 7.25$$