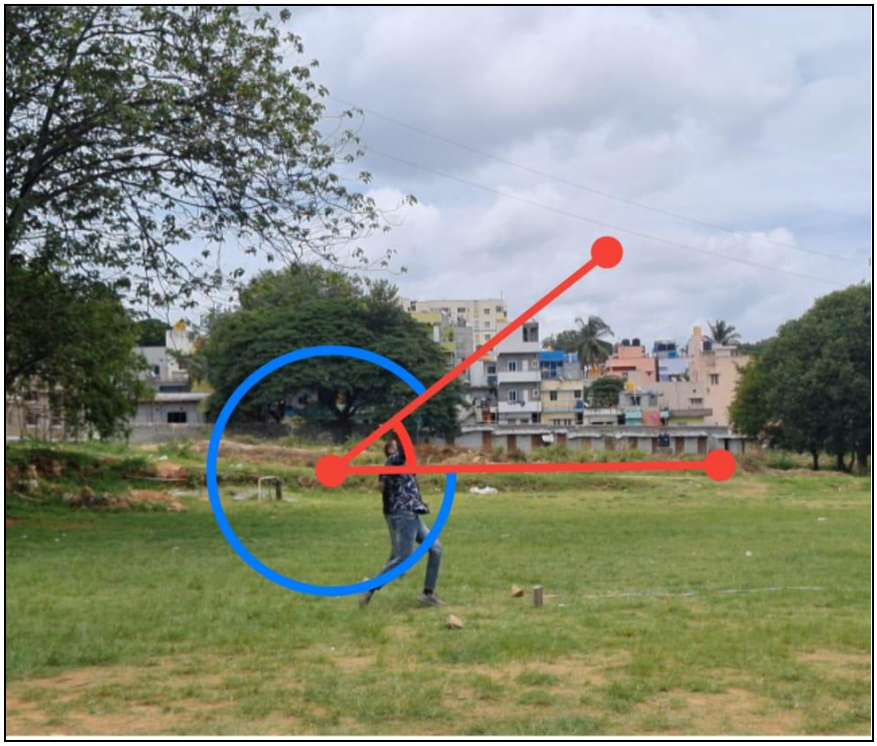
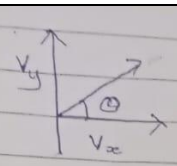
Science behind Neeraj’s success

Calculating the angle at which the javelin was thrown:



Date taken: 09/07/2023, 12:43

a:37.5°



Horizontal velocity $= V_x = V\cos\theta$
Vertical Velocity $= V_y = V\sin\theta$
Release angle $= \theta = 37.5°$
Time $= t = 1.33$ seconds
Acceleration $= a =$ (here using g)
$g =$ a due to gravity

$$S_y = U_y t - 1/2\, g t^2$$

$$= (V\sin\theta \times t) - (1/2 \times 9.8 \times t^2)$$

$$0 = V\sin(37.5) \times 1.33) - (1/2 \times 9.8 \times (1.33)^2$$

$$= V \times 0.60 \times 1.33 - 4.9 \times (1.33)^2$$

$$= V \times 0.798 - 8.66$$

$$8.66 = 0.798\, V$$

$$V = \frac{8.66}{0.798}$$

$$= 10.85 \text{ m/s}$$

$S_x = U_x \times t$
$= (V\cos\theta + V_{tail}) \times t$ (Here $V_{tail} = 1.94$)
$= (10.85\cos(37.5) + 1.94) \times 1.33$
$= 16.55 \times 1.33$
$= 14.02$ m

Measured value:

Time = 1.338sec

Distance = ~~H=5m~~ 14.02m

Vinit = 1.94

Measured value = calculated value

{ In this question we need to find horizontal range at 2 different angles, that is, 45° (D_{max}) & 36° (D_{max})

Maximum horizontal Range = R_{max}

Horizontal range at 45° = $\frac{u^2 \sin 2\theta}{g}$

$= \frac{(10.85)^2 \times 1}{9.8}$ ($\sin 90° = 1$)

$= \frac{117.72}{9.8}$

$= 12.01$ m

Horizontal range at 36° = $\frac{u^2 \sin 2\theta}{g}$

$= \frac{(10.85)^2 \times \sin(72°)}{9.8}$

$= \frac{117.72 \times 0.95}{9.8}$ ($\sin 72° = 0.95$)

$= \frac{111.95}{9.8}$

$= 11.42$ m

Observations:

- Based on these calculations, the javelin thrown at a 45-degree angle is expected to travel farther (about 12.01 meters) than the javelin thrown at a 36-degree angle (about 11.42 meters).
- This demonstrates that the launch angle significantly impacts the javelin's performance. A launch angle closer to 45 degrees tends to maximize the horizontal distance (range) in projectile motion, assuming all other factors are constant.