Heisenberg Uncertainity principle

According to classical physics if one knows initial position, velocity, and all the forces acting on a particle, then the position $\vec{r}(t)$ and velocity $\vec{v}(t)$ are uniquely determined by means of Newton's 2nd law. classical physics is DETERMINISTIC.

In quantum mechanics particle is represented by means of wave function, and since the wavefunction cannot be localized, then the microscopic particle is somewhat spread over space. Therefore classical concept of exact position, exact momentum and unique path doesn't make sense in microscopic scale.

Heisenberg uncertainity principle states that: If x component of the momentum of a particle is measured with an uncertainity Δp_x, then its x-position cannot at the same time, be measured more accurately than $\Delta x = \hbar/2\Delta p_x$.

$$\Delta x \, \Delta p_x \geq \hbar/2$$

$$\Delta y \, \Delta p_y \geq \hbar/2$$

$$\Delta z \, \Delta p_z \geq \hbar/2$$