a) Parameters for Maximum Angle of Inclination in TWSBR

Center of Gravity (CoG): The position of the CoG is crucial for stability. A higher CoG can reduce stability, leading to a lower maximum angle of inclination.

Wheel Base Width: The distance between the two wheels affects the robot's stability and its ability to recover from an inclined position.

Inertia and Mass Distribution: The distribution of mass and the moment of inertia affect how the robot responds to tilting forces.

Sensor Precision: Accuracy of gyroscopes and accelerometers in detecting tilt and motion.

Motor Torque and Response Time: The capability of motors to correct the inclination quickly.

Surface Friction: The friction between the wheels and the ground which influences traction.

Control Algorithms: The effectiveness of the PID (Proportional-Integral-Derivative) or other advanced control algorithms in stabilizing the robot.

Battery Weight and Placement: The battery’s weight and its position can impact the balance and inclination angle.

External Forces: Environmental factors like wind, slope of the terrain, and load variations.

b) Core Concept of TWSBR

The core concept of TWSBR revolves around maintaining dynamic stability using real-time feedback from sensors and actuators. This involves:

Gyroscope and Accelerometer Data: Collecting data about the robot’s orientation and motion.

Control Systems: Implementing control algorithms (such as PID control) to process sensor data and adjust motor outputs to keep the robot upright.

Actuation: Using motors to drive the wheels and correct any deviation from the vertical position.

Feedback Loop: Continuously adjusting the robot’s position through a closed-loop feedback system to maintain balance.

c) Additional Component to Make TWSBR

Unique

Adding a Vision System with AI Capabilities:

Proof of Concept:

Component: A camera system integrated with an AI processor (such as NVIDIA Jetson Nano) for real-time image processing and object detection.

Functionality: This system can identify obstacles, recognize paths, and interact with the environment intelligently.

Application: Using AI, the robot can navigate more complex environments autonomously, avoiding obstacles and finding optimal paths.

Implementation:

Hardware: Camera module, AI processor, power supply.Software: Computer vision algorithms (using OpenCV), machine learning models (using TensorFlow or PyTorch) for object detection and path planning.

Benefit: Enhances autonomous navigation capabilities, making the robot more versatile in different applications like delivery services in dynamic environments.