**METHODOLOGY**

An active suspension system is a sophisticated automotive suspension variant that utilizes an onboard control system to manage the vertical movement of a vehicle's wheels and axles in relation to the chassis or vehicle frame. This is in contrast to conventional passive suspension systems that rely solely on large springs for static support and damping vertical wheel movements caused by road surfaces (as defined by Wikipedia). In the scope of this project, the utilization of actuators, controllers, and various sensors aims to govern the vertical movement of an individual car wheel, employing a custom road input approach rather than the traditional reliance on a G-sensor for ground sensing.

The primary objective of this project is to observe and analyze the real-time behavior of a single active car wheel suspension. To accomplish this, the system integrates an Arduino microcontroller as its central processing unit, servos as actuators, and additional sensors such as load cells and a motor speed detector. The Arduino microcontroller is programmed to receive input from both the road data and load cells, utilizing this information to output control signals to the motor drivers, wheel speed, and the status of the actuator, particularly the servos. This comprehensive system aims to enhance ride quality and car handling by ensuring consistent tire alignment with the road during cornering, minimizing undesired contacts between the vehicle frame and the ground (especially over depressions), and overall improving traction and steering control.

When the car encounters a bump, the active suspension system reacts by absorbing the impact, facilitating the maintenance of tire-to-road contact. The electronic signal generated by the road input actuator, in response to the bump, is transmitted to the microcontroller. Subsequently, the servo controlling the vertical movement of the car wheel compresses to absorb the impact. Although the car's speed momentarily decreases due to suspe­­­­­­­nsion compression and wheel upward movement, the microcontroller endeavors to restore the speed to its previous level once the bump is traversed. Upon reaching level ground, the servo relaxes, reducing the impact on the car body, and the speed returns to its original state.

Similarly, when the car encounters a pothole, the road input generates an electronic signal directed to the microcontroller. The servo responsible for the vertical movement of the car wheel extends to alleviate the impact on the car body. The entry into a pothole can have a more significant impact on the car's speed compared to a regular bump, given the sudden and deep nature of the pothole. The suspension extends to cover the pothole and absorb the shock. The microcontroller aids in adjusting the motor speed to safely navigate the pothole. After passing the pothole, the motor speed gradually returns to normal as the suspension relaxes—all achieved through the microcontroller's programmed implementation of a PID-type feedback control system.