

Automatic-Frictionless-Speed Braking System

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India faces the highest number of accidents and accidental fatalities in the world. It is caused mainly due to over speeding of vehicles. but this is not only the sole cause. There are often cases when the driver becomes careless, or if the obstacle in the vehicle's path comes all of a sudden that before the human reflex response, the mishap occurs. Sometimes even after being alert there comes the same negative outcome, the one prime reason behind it is that the brake shoe has undergone wearing and as a result it failed to decelerate the vehicle. Often it occurs that the driver couldn't spot the speed breaker on its way, and so the car tries to cross it with the high initial speed and as a result both the vehicle and the passengers suffer.

In order to avoid these types of problem I thought of designing a braking system.

Just decoding the Mechanism from the name , by splitting it into 2 parts-

- (i) Automatic
- (ii) Frictionless

Automatic : Here with the help of Arduino as its microcontroller and Sensors the vehicle will be able to detect the presence of any obstacle in its path and act accordingly without any manual interference. This braking system will be added as an additional emergency brake to any vehicle, in case the manual brakes fail, either due to human error, or its own damage due to wear and tear. The brakes being automatic, turns on automatically after detecting any obstacle on its path when the car and the obstacle crosses a specific range of proximity. This prevents from any mishappening, which might have occurred due to carelessness of the driver, or if the obstacle comes on the vehicle path suddenly and without this braking system, it would have collided with it before the human reflex could make any response. Also, if the brake shoe has undergone severe wear and tear, or any other internal malfunction that sometimes the brakes fails to decelerate the car even after pressing them hard. Sometimes it also happens when the driver due to any reason could not spot the speed breaker ahead of it, and the vehicles suffer jerks and damages, hurting the passengers. The brakes being automatic gets activated automatically on sensing such impediments, thus helping to prevent these mis happenings and ensuring a safe drive. Many a times it happens when the driver presses the brake insufficiently as a result the vehicle continues rolling and does not stop where the driver wants it to, leading to an accident. The automatic braking system would serve as a helping mechanism in this situation too.

Frictionless : The most common braking system is the use of Brake shoes fitted with brake linings (friction material) which press against the drums from the inside to generate braking force. With this system, friction is generated by pressing the brake linings against the inside surfaces of the drums

which decelerates the vehicles. Friction here acts as the greatest hidden demon in this type of braking system. Though friction is the main cause behind decelerating the vehicle, but it secretly eats off the brake shoe, due to wear and tear and a time comes when the shoe fails to decelerate the car even after the brakes being pressed hard. This happens without the prior knowledge of the driver and as a result accident happen. To prevent this frictionless braking system is used that uses eddy current phenomenon.

Eddy current brake(frictionless brake) :

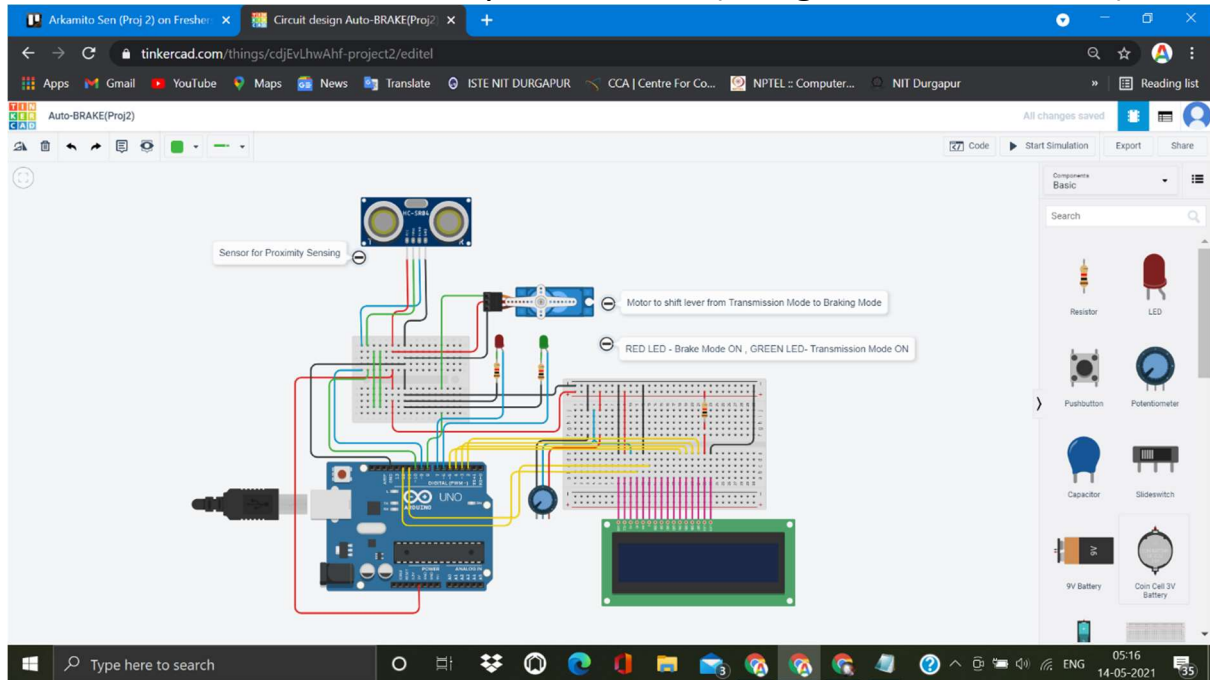
Majority of braking system work on the principle of dissipation of kinetic energy to heat energy. This method has its own drawbacks and must be replaced with more reliable braking system that is quick in response, doesn't heat and also maintenance free. In this project, a frictionless braking system is proposed using eddy current phenomenon. This phenomenon is governed by Faraday's law of electromagnetic induction and Lenz law. Eddy current is created by the relative motion between a magnet and a metal(or alloy) conductor(braking disc). The current induces magnetic fields in the conductor which opposes the actual magnetic field of the magnet and results in the deceleration of motion (Lenz law).

An eddy current brake like a conventional friction brake is device used to slow or stop brakes, in which the drag force are used to stop the moving object provided between two surfaces pressed together by friction, the electric current brake called eddy current brake whose drag force is an electromagnetic force between a magnet and a nearby conductive object in relative motion, because of the eddy currents induced in the conductor through electromagnetic induction.

Automatic Braking Mechanism:

- Obstacle Sensing Mechanism:

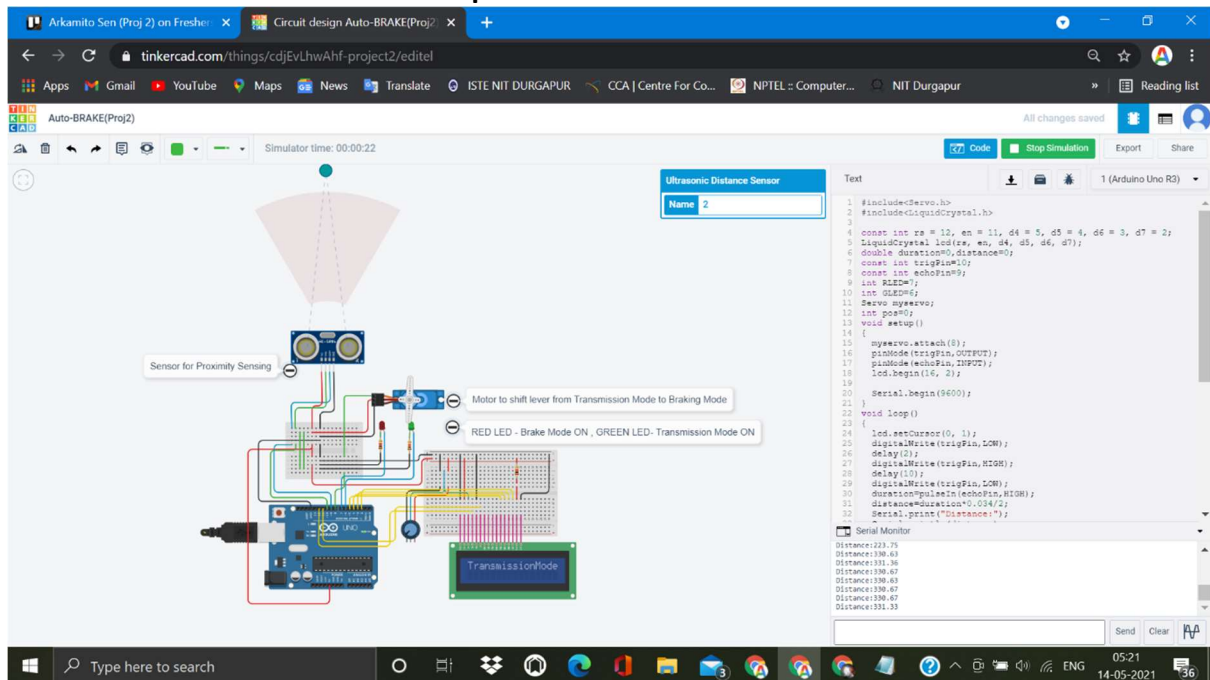
Obstacle Detection and Response Circuit(designed in TinkerCAD) :



This mechanism uses a HC-SR04 Ultrasonic Sensor to detect the presence of any obstacle on its path withing a specified proximity of (pprox.. 20-400cm). During Normal drive the green LED glows indicating "Transmission Mode ON" which is displayed on the LCD screen, which means there is no detected obstacles on the vehicle path and that the vehicle is in normal transmission mode. As soon as the obstacle enters the specified range, the sensor detects it and turns on the Response Mechanism, the red LED starts to glow, and the green LED turns out, indicating that the Transmission Mode has been turned off and "Brake Mode ON", which is displayed on the LCD screen.

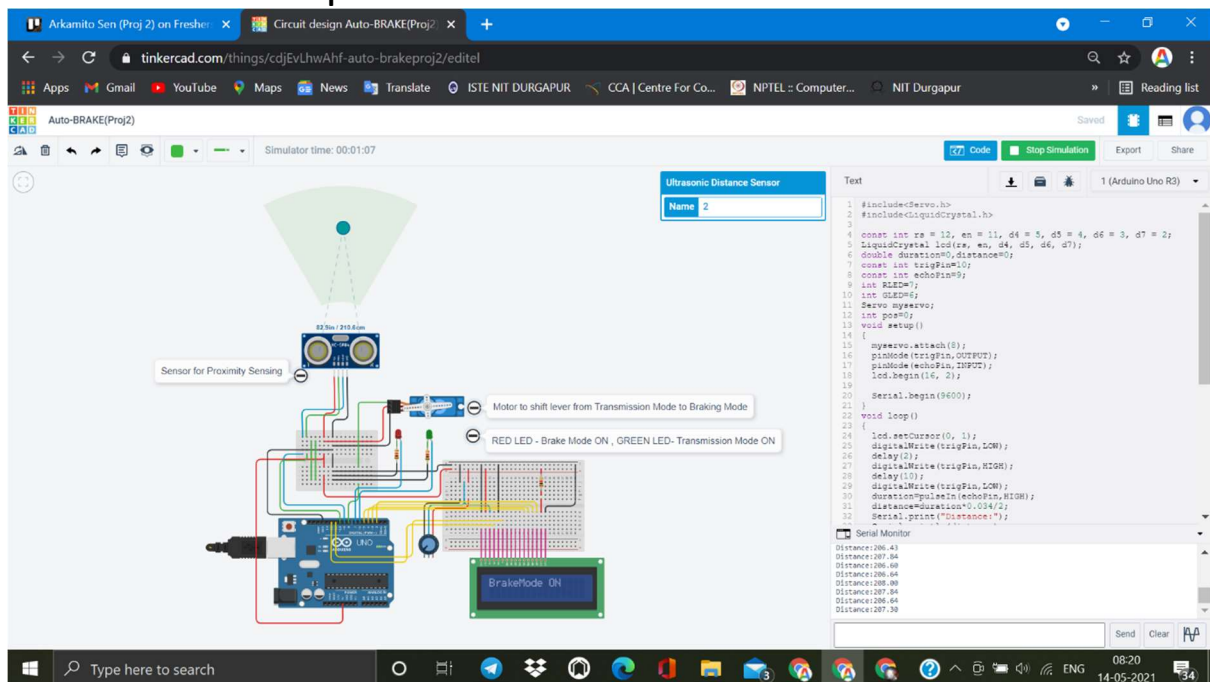
- Response Mechanism:

Transmission Mode Response:

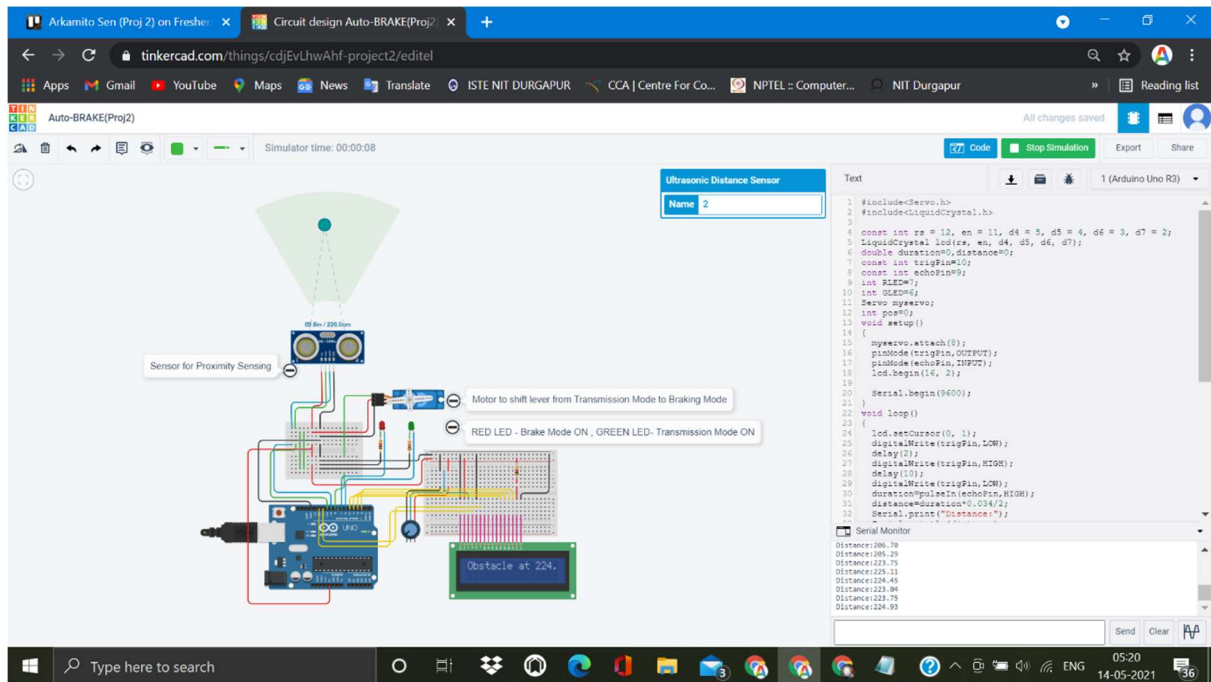


From the simulation we can see that when the obstacle is beyond the range the LCD screen displays "Transmission Mode", the green LED glows, and notice the Servo motor horn position.

Brake Mode Response:



From the simulation we can see that when the obstacle is within the range the LCD screen displays "Brake Mode ON", the red LED glows, and notice the Servo motor horn position which has changed from the initial position (turning ON the Brake Mechanism)

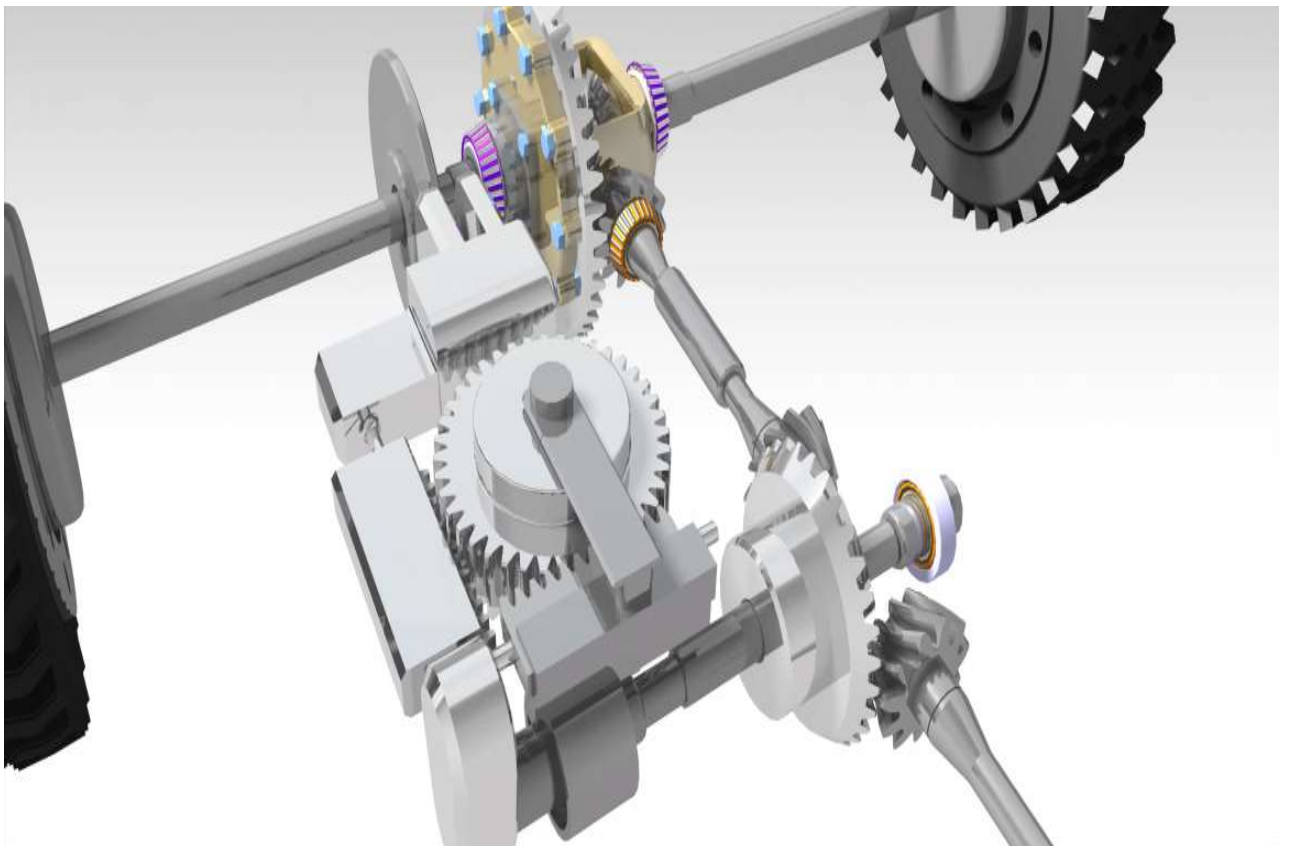


LCD Screen displaying distance of the obstacle from the vehicle.

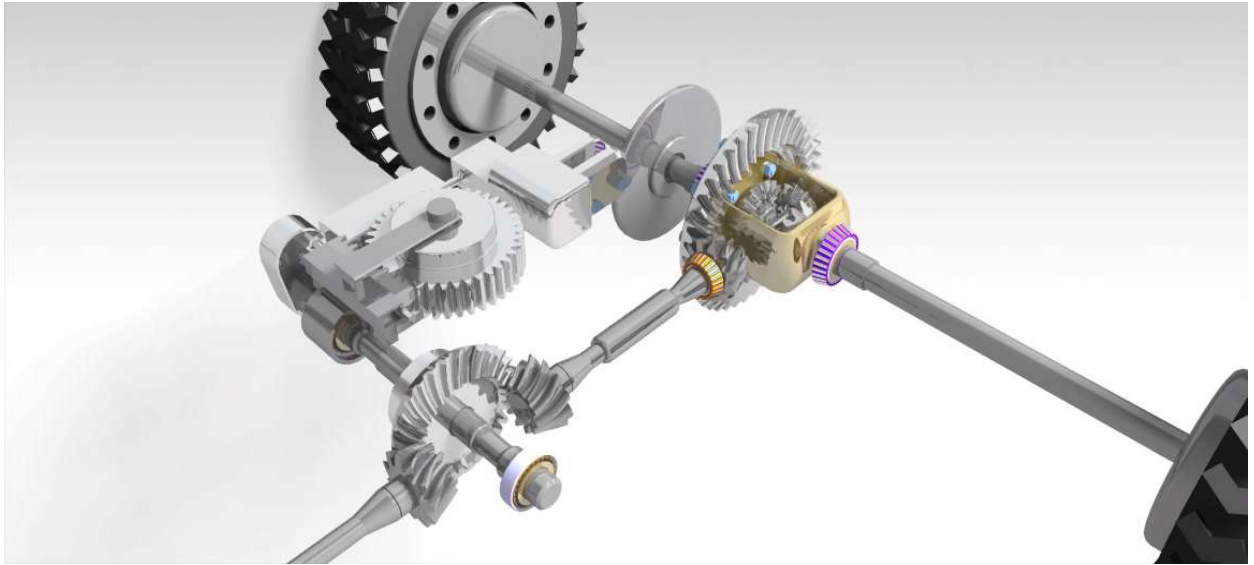
- Braking Mechanism:



(Product designed and Rendered by me in CATIA v5)



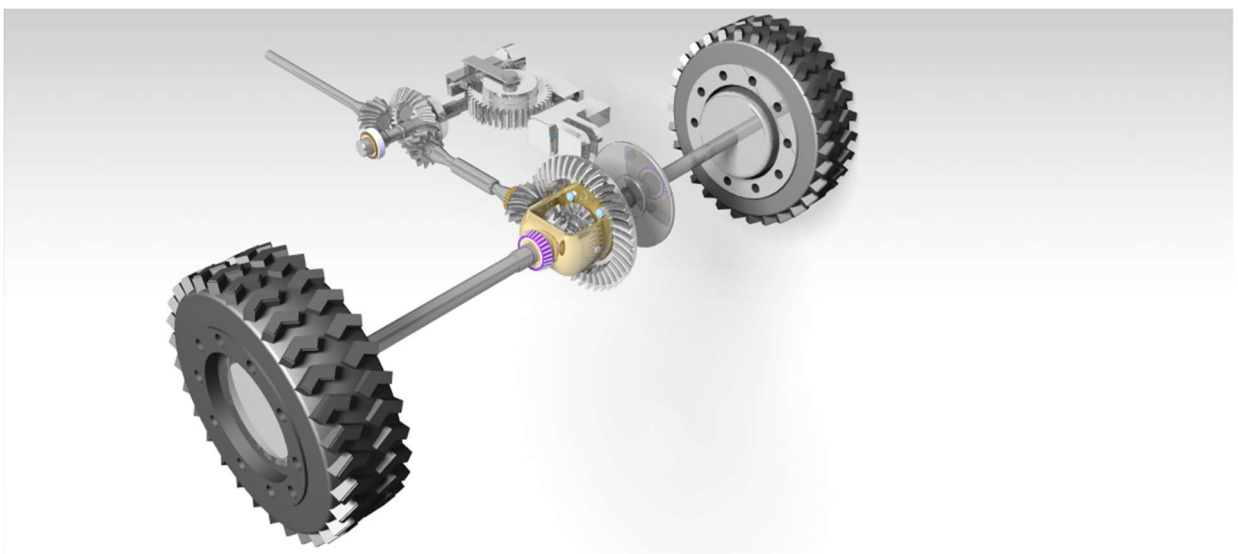
(Assembly design of the Braking Mechanism in CATIA v5)



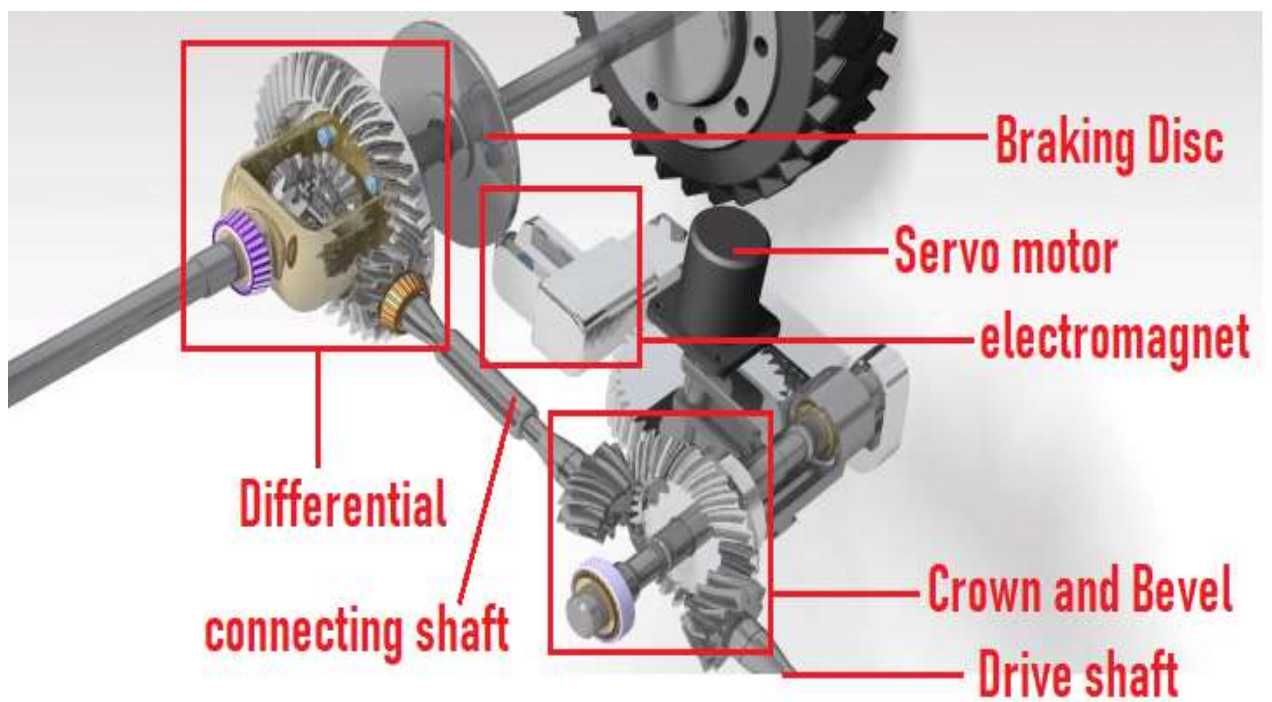
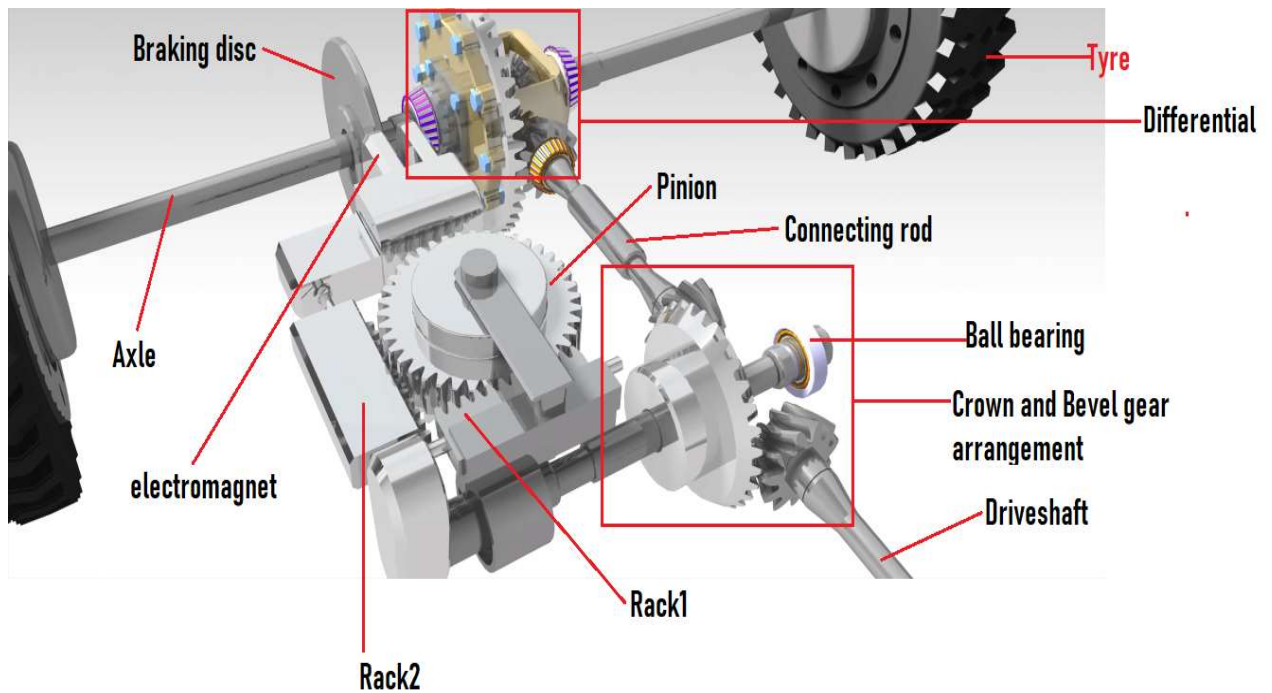
(Assembly design of the Mechanism as viewed from Bottom)



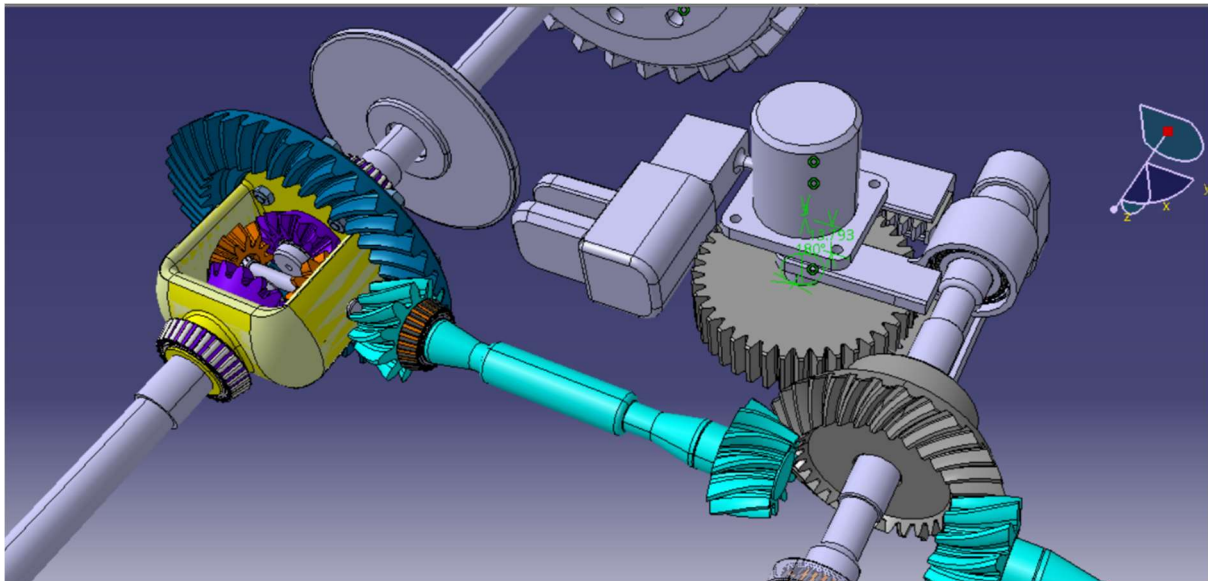
(Assembly design of the Mechanism as viewed from the Top)



(Isometric view)

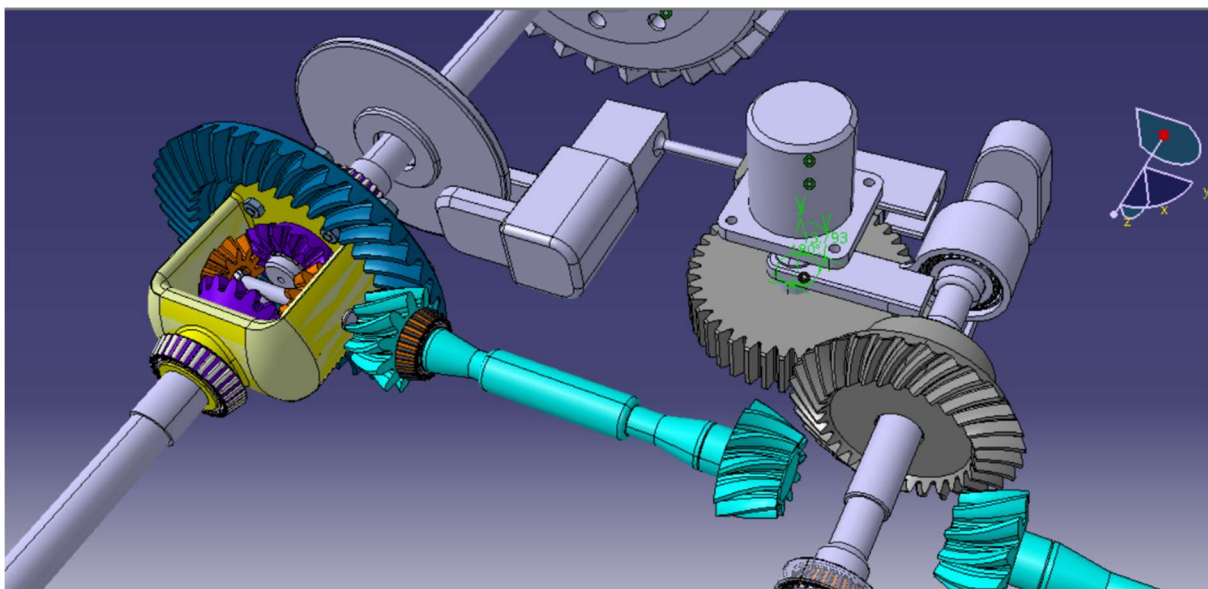


When the Normal “Transmission Mode “ is ON, the servo motor has its horn at the initial position. At this position the Crown gear in the Crown and Bevel arrangement is meshed with the other two bevel gears, so as the result the power from the Drive shaft gets transmitted through the Crown-Bevel gear arrangement, to the connecting shaft, and then to the Differential.



(Catia v5 Assembly showing Transmission Mode ON ; the Crown gear meshed with the other two Bevel gears, serving as a connection between the Driving shaft, and the Connecting rod ; and the electromagnet away from the braking disc.)

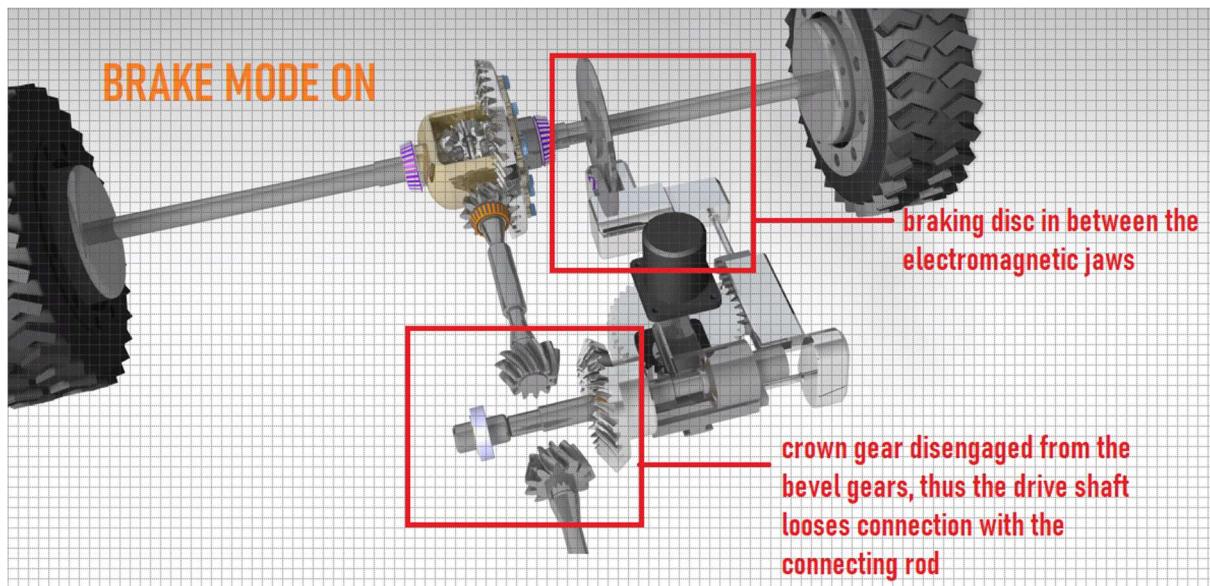
As soon as the Response System shifts the power from Transmission Mode to Brake Mode, the servo motor turns on and rotates the Pinion by some angle, due to which the Rack1 and Rack2 which is meshed with the Pinion and at right angles to each other also moves simultaneously.



(Catia v5 Assembly showing Brake Mode ON; the Crown gear disengaged from the 2 bevel gears, thus disconnecting the drive shaft from the connecting rod; and the Rack2 moves forward as a result the braking disc comes in between the electromagnetic jaws.)

The Rack1 moves and disconnects the Crown gear from the two Bevel gears, as the result the driveshaft gets disconnected from the connecting rod, and so the rotation of the Drive shaft has no effect on the car, the car is now moving due to its own inertia of motion. On the other hand the Rack2 which is connected with the electromagnet moves forward and the braking disc is now in between the electromagnetic jaws. Eddy currents are developed in the Braking disc having magnitude proportional to the magnetic flux, which is directly proportional to the speed of rotation of the disc.

The kinetic energy of the rotating disc, gets converted to heat energy and the disc stops rotating, thus decelerating the vehicle and bringing it to stop immediately.



Electromagnet used: This mechanism uses an electromagnet that is constantly magnetized by the current generated due to rotation of the vehicle wheels, this helps to produce a constant strong magnetic field in the electromagnet, so that when the brakes are activated it does not take additional time to at first magnetise itself and then produce effect on the braking disc.

Air-gap in between the electromagnet and the braking disc: Air-gap will produce a stronger magnetic field. The smaller the air gap, higher will be the strength of magnetic flux induced, and better will be the braking effect of the electromagnet.

ADVANTAGES

a. Abrasion Free

The existing braking system uses a mechanical blocking which leads to high levels of wear and tear of the system specifically in automobiles reducing the life of the systems.

b. High Braking Force

The Drum and Disc braking system does not produce high braking forces for inhibiting systems moving in high speed which give thrust to a need for an effective braking of high speed machines.

CONCLUSION

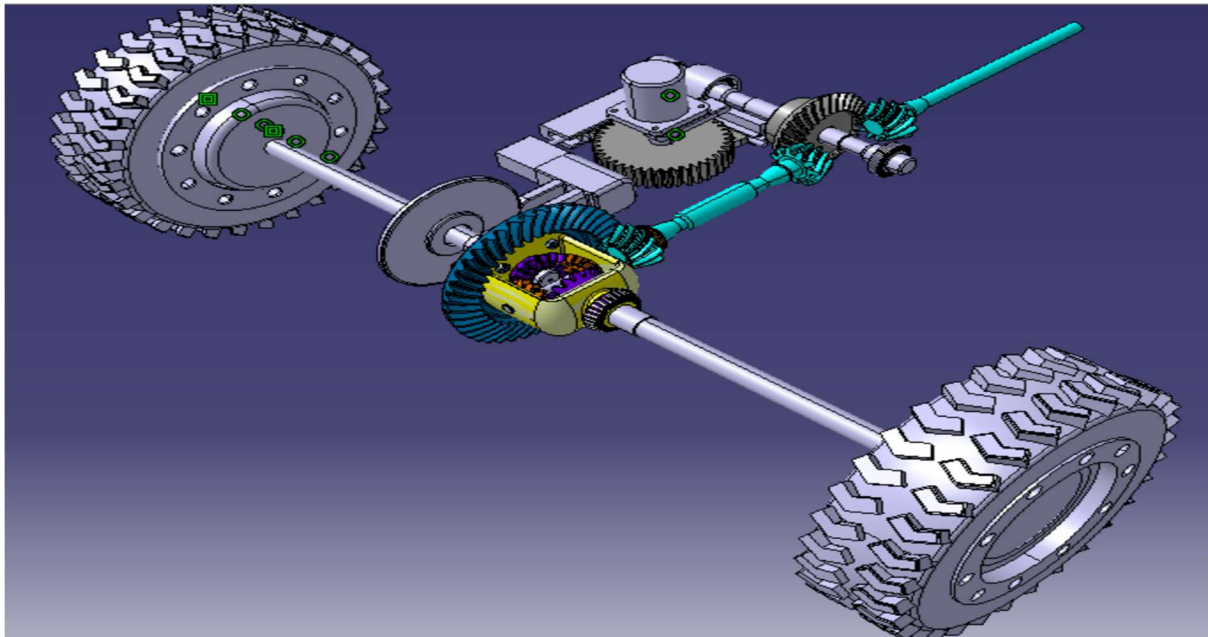
The ordinary brakes which uses a mechanical blocking can causes three main problems skidding, wear and tear of the vehicle. The ordinary brakes which has these drawbacks can be overcome by a simple and effective mechanism of braking system 'This eddy current brake is an Abrasion-free method which can be implemented in vehicles including trains. Another advantages is of high reliability and safety. This alternative and effective method of braking system can work even in the toughest environmental conditions.

The braking system being made Automatic, helps to mitigate crashes by initiating braking when hazardous conditions arise or if the driver presses the brakes insufficiently.

In the rapidly changing world, the speed has become an important factor in human's life.

Everyone wants to get fast as much as possible. In the fast speed world, there are two perspectives, one is keeping speed and another is to maintain safety mediums as well. So keeping speed is quite easy for a person and in case of safety mediums, there must be a lot of attention.

The Automatic Frictionless Braking System will serve as a major step to keep up with the pace of human life, with both speed and safety.



(Catia v5 Assembly design model)