

## Electric powered self-tilting trike : design and development of a tilt by wire system Part 2

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## Background

The aim of this research is to maximize the efficiency of a vehicle especially in a sharp turn by using tilting mechanism. Unlike bicycle which can tilt while turning in a high speed, 3 or 4 wheels vehicle loses some energy in turning due to the lack of stability caused by centrifugal force. The proposed approach is by combining the efficiency provided by tilting mechanism and the convenience and safety from a conventional car.

The inability of a conventional car to tilt as a bike in a curve is proven to cost it to lose its stability and hence its efficiency. When a vehicle turns in a high speed, one of its outer wheel will eventually lost its traction and the energy will be wasted.

On the other hand, tilting mechanism provides some leeway for the tilting resultant force to consistently fall in between the wheel base region, so that the vehicle can turn faster stably. However, to ride a vehicle which enable tilting is not intuitive for everyone since it requires the ability to ride a bike and a low centre of gravity point makes it extremely hard to tilt using body weight. Hence, the idea of creating an automatic tilt vehicle or tilt by wire comes alive.

## Mechanical System

Tilting system of a vehicle can be effectively achieved by installing a parallel bar mechanism to allow the vehicle's body to rotate relatively to the ground. This mechanism is an ideal system to reduce friction force due to wheel scrubbing while tilting in a curve.

The automatic tilt or tilt by wire, however, requires additional motor to assist the relative movement provided by the parallel bar. To achieve high accuracy of tilting angle performed, stepper motor is used as the main actuator in the vehicle.

## Electronic System

The automatic tilting mechanism is achieved by the help of Arduino which in turn commands a stepper motor to tilt according to the required tilting angle. Required tilting angle is an output with velocity and turning radius as the variables. The flowchart of the Arduino program is listed below:

## Additional Features

To further enhance the driving experience of the vehicle, a switch inside the cockpit is installed to change the driving mode from auto-tilting (controlled by Arduino) to manual tilting (controlled by the driver via left and right-tilt button). This feature allow the driver to explore an entirely new experience in driving with tilting.

