Better Speed Control

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Like everything else, cars carry their history. Before cars, there were carriages (buggies) pulled by horses. When the horses were dashing (running), their heels threw mud into the carriage, so a carriage had a dash board at its front side to keep the mud out. Today's cars aren't pulled by horses, but we still call the front of the cabin (passenger area) the dash board, or the dash.

This essay is about the speed control of cars. But first, here is an instructive analogy. I lived in a building whose apartments had a peculiar heat control. In the winter, hot water was pumped around the building in pipes in the ceilings of the hallways. At each apartment, there was a branch pipe from the hall pipe, so water could be diverted just into and then immediately back out of the apartment, rejoining the hall pipe. A fan blows air over the branch pipe, which heats the air and blows it around the apartment. In the summer, cold water is pumped through those same pipes around the halls; diverting it into the branch pipe, and blowing air over the branch pipe, results in air conditioning. The thermostat to control this heating and cooling arrangement had two wheel-dials. One dial controlled the gate that diverted the water into the apartment, so you can divert more or less as you choose. The other dial controlled the fan speed. To the people who designed and built this method of heating and cooling, the thermostat seemed reasonable: perfect control over the two moving parts. But the people who lived in the building didn't know or care how the heating and cooling worked, and they didn't understand the control. They wanted to choose a temperature, and let the heating and cooling system figure out how to deliver the desired temperature.

Now back to cars. The speed of a gasoline-powered car is controlled by two pedals: the gas pedal, and the brake pedal. For the first fifty years, from about 1900 to 1950, cars had a third pedal: the clutch pedal (and a few cars still do today). But you don't have three feet. Fortunately, you almost never need to press the gas pedal and the brake pedal at the same time, so the same foot can be used for both of them. When you are stopped facing up a hill, starting does require clutch, brake, and gas all at the same time. So there's a handbrake for that purpose. Even though cars don't have clutch pedals anymore, we still use the same foot for both gas pedal and brake pedal. Maybe that's a good practice because you won't accidentally press both the gas pedal and the brake pedal at the same time. And we still have a handbrake, and maybe that's good as added safety for parking on hills.

Originally, the gas pedal directly, mechanically, controlled the flow of gas into the engine, by opening or closing the throttle. And originally, the brake pedal directly, mechanically, controlled the brake by pressing it against a wheel. Now these controls are indirect and more complicated, through layers of software and small electric motors, but the effect is the same. If you want to travel at a particular speed, you must press the gas pedal more as you go uphill, and less as you go downhill, possibly switching to the brake pedal as you go downhill, just to maintain a constant speed. The pedals do not allow you to choose a speed, nor to choose an acceleration. The gas pedal allows you to choose how much gas flows to the engine, and therefore how much power goes to the wheels. The brake pedal allows you to choose how much friction is applied to the wheels, and therefore how much braking power goes to the wheels.

Cruise control serves two purposes: it allows you to choose a speed, which the car will maintain automatically; and it gives your gas pedal foot a rest. But it doesn't allow you to choose the acceleration or deceleration used to reach and maintain your chosen speed, so you may be thrown backward or forward as the car accelerates and brakes. Current cruise control design requires your hands, which are already occupied with steering, and makes changing the desired speed too clumsy for continuous control.

Cars with electric engines are becoming more common, and in the future all cars may be electric. They may also be self-driving, but I want to talk about the speed controls for human drivers. At present, it's the same two pedals, except that the gas pedal is now called the accelerator (gas pedal is not appropriate for an electric car).

An electric motor is just as good at providing deceleration as it is for providing acceleration. For acceleration, the rotating magnetic field is timed to be ahead of the shaft rotation, driving it faster. For deceleration, the rotating magnetic field is timed to be behind the shaft rotation, slowing it down. An electric motor is powerful enough provide more acceleration than is comfortable, and more deceleration than a human occupant can stand. And it does so without mechanical friction that wears out mechanical brakes. Mechanical braking converts forward momentum into heat, which is lost; electrical braking converts forward momentum into electrical energy that charges the battery, and is not lost (regenerative braking). Electric cars currently use electrical braking to supplement mechanical braking for the purpose of saving energy. Perhaps some electric car manufacturer will soon realize that mechanical brakes are unnecessary.

Gasoline motors turn in only one direction, with a small range of turning speeds (rpm), so they need different gears for different vehicle speed ranges, and a reverse gear for going backwards. Electric motors have a much greater range of turning speeds, and they can turn in either direction (forward and backward), so no gears are needed.

A car driver is not interested in the mechanics or electronics of how a car changes speed, so the controls should not reflect the mechanics or electronics. A driver does not want to choose the power that goes to the wheels. A driver wants to choose a speed, and to choose the amount of acceleration or deceleration used to reach the desired speed. Here is my proposal.

Since the hands are occupied with steering, a pedal is appropriate. Not two pedals; just one. The pedal is a partial shoe, so the front half of a foot fits into it. It has a neutral position that maintains the current speed. In this position, the pedal's upward pressure just balances the weight of the foot, so the foot is relaxed, with no effort required to stay in that position. In that position, the car automatically increases the power to the wheels when necessary (for example, going uphill), and decreases the power or brakes (if the car is electric, that's motor braking) when necessary (for example, going downhill), in order to maintain the speed.

To increase the speed, press your foot down. Press it more for more acceleration, and less for less acceleration. As you approach the desired faster speed, return your foot to the neutral position, arriving there when you reach the desired speed. To decrease the speed, raise your foot. Raise it more for more deceleration, and less for less. As you approach the desired slower speed, return your foot to the neutral position, arriving there when you reach the desired speed. This is also the control for stopping, resulting in a smooth stop, and a relaxed foot to stay stopped.

There are two reasons why acceleration is pressing down, and deceleration is raising up, rather than the opposite. The most important reason is that if the driver removes their foot from the pedal, the pedal pressure raises the pedal, resulting in deceleration until stopped. This is known as the dead man's switch. The other reason is that acceleration tends to move the driver's foot backward, and deceleration tends to move the driver's foot forward, which is stabilizing negative feedback.

Different drivers have different leg and foot weights. So when a different driver sits in the driver's seat, in addition to adjusting the seat position and mirrors, the neutral pedal position needs to be adjusted. Just relax your foot and push a button.

In 1988 I was greatly impressed by the book *the Design of Everyday Things*, by Donald Norman (also published as *the Psychology of Everyday Things*). I learned that many things around us could be designed better with just a little thought. But we are used to them, and we don't think how they could be better. We continue to make them the way we've always made them; their designs have inertia. Being used to the way things are gives us the feeling that that's the way they should be, and can prevent us from recognizing that a new design is better. I would like to know whether my proposal for speed control is better. That requires building it and testing it, and I don't have the resources to do that.

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