

# Using Autonomous Vehicles and Smart Technology to Reduce the Environmental Impact of Transportation

Joel Harrison, Afsaneh Minaie  
Computer Engineering Program  
Utah Valley University  
Orem, Utah  
minaieaf@uvu.edu

Transportation is the leading cause of carbon monoxide and nitrogen oxides being released into the atmosphere. Automobiles, in and of themselves, are actually fairly efficient machines; but when you add up all the vehicles on the road, the emissions become dangerous. Knowing how many vehicles are on the road around the world is nearly impossible, but the International Energy Agency estimates that by the year 2035 there will be close to 2 billion passenger vehicles on the road throughout the world [1]. As China and other countries continue to develop their transportation infrastructure, this number could increase drastically.

With so many cars flooding the world, automobile manufacturers need to start now to reduce the oil consumption and toxic emissions through smart technology in their vehicles. Autonomous vehicles (AV) are one way to accomplish this goal. AV's are typically electric, which in the long run is more efficient than gasoline and therefore reduces the carbon needed to run them. All-electric vehicles (EV) have the lowest amount of CO<sub>2</sub> emissions compared to gasoline, hybrid, and plugin-hybrid with an average of 5000 pounds of CO<sub>2</sub> per year per vehicle [2]. Gasoline CO<sub>2</sub> output is over 10,000 pounds per year per vehicle.

Since EV's have zero tailpipe emissions, their CO<sub>2</sub> contribution comes from the energy source used to charge the vehicle. As the smart technology in transportation evolves, more charging stations will be created where the energy used to charge vehicles is gathered from more environmentally friendly means, i.e. solar, wind, clean burning natural gas, etc.

The Internet of Things (IoT) will play a large role in reducing the amount of emissions from vehicles. The autonomous vehicles should have the capability to communicate with intersections, railroad crossings, and other critical areas where idling is a problem. AV's need the ability to calculate the amount of time it would spend idling at the next stop light and change its course if an alternate route would be faster and reduce the amount of energy required to get to its destination.

Stoplight efficiency will increase when autonomous vehicles rule the road. Imagine a stoplight that turns green; theoretically, every car should be able to begin moving immediately, but do to human reaction times and distracted driving, it can take some time for every car to be in motion. With autonomous vehicles this problem will be solved. Every car can begin moving immediately if they know that all the cars in front of them are also going to be moving immediately. This allows for more vehicles to get through the intersection and thus reduce critical idling time. Gasoline vehicles will use less gas, and EV's will be able to go longer distances between charges.

Traffic flow on the freeway will be much smoother even in heavily populated areas. Getting updated traffic reports and communicating with other cars on the road will help determine alternate routes which will help reduce traffic jams. Due to smoother traffic flow, speeds can be adjusted for optimal energy consumption. Cars may be going slower on the freeway, but they will get to their destination faster due to the reduction of stop and go traffic.

This project consists of creating a scaled down version of an autonomous vehicle using a remote control car to show how smart technology can be used to increase transportation efficiency. An Arduino

microcontroller is used along with GPS, WiFi, magnetometer, motor controller, and ultrasonic sensors to autonomously navigate to various waypoints while receiving updated traffic information and correcting its course to reduce the amount of time spent on the road.

The WiFi capability of this vehicle acts as the communication center and gathers information sent from intersections and other critical areas. A smartphone app performs the information transmission to the car and can simulate various conditions that autonomous vehicles may encounter. Information about an accident up ahead, traffic lights that are malfunctioning, and a variety of other obstacles can be sent directly to the vehicle and course correction can take place.

The abilities of this remote control car are just the beginning of what can be accomplished as the evolution of autonomous vehicles unfolds.

## References

[1] *World Energy Outlook 2012*, 1st ed. International Energy Agency, 2016, p. 4.

[2] "Alternative Fuels Data Center: Emissions from Hybrid and Plug-In Electric Vehicles", *Afdc.energy.gov*, 2016. [Online]. Available: [http://www.afdc.energy.gov/vehicles/electric\\_emissions.php](http://www.afdc.energy.gov/vehicles/electric_emissions.php). [Accessed: 17- Sep-2016].