Delphi Automotive Systems: Safe - Green - Connected

Design Team #1
Team Excalibur
Fall 2014

Submitted to:
Professor Berezniak

College of Engineering
School of Engineering Design, Technology and Professional Programs
Penn State University

08 Dec 2014

Innovation for the Real World

Ultimate goal is to help make zero fatalities, zero injuries, and zero accidents a reality

Passionate about creating a world with zero emissions

Technology to allow seamless connectivity in the vehicle – it’s what consumers want, and we can make it a reality
ACKNOWLEDGMENTS

Penn State University

- Dean, College of Engineering
  Amr Salah Elnashai, Ph.D.
- Department Head, SEDTAPP
  Sven Bilén, Ph.D., PE
- Course Instructor
  Prof. John Berezniak
- Laboratory Assistants
  Heather Dawe, Nuclear Engineering Major

Delphi

- Troy Offices and Innovations Center
  Troy, Michigan
  5725 Delphi Drive
# TABLE OF CONTENTS

## SECTION 1. EXECUTIVE SUMMARY

## SECTION 2. INTRODUCTION

2.1 PROJECT OBJECTIVES  
2.2 PROJECT BACKGROUND  
2.3 SPONSOR BACKGROUND  
2.4 PROJECT CATEGORIES  
2.5 PROBLEM STATEMENT

## SECTION 3. METHODOLOGY

3.1 PROPOSED DEVICE DESCRIPTION  
3.2 RATIONALE FOR SELECTION  
3.3 CUSTOMER NEEDS  
3.4 OBJECTIVES AND GOALS  
3.5 CONCEPT OF OPERATION  
3.6 SYSTEM CONTROLS  
3.7 SYSTEM MODEL  
3.8 DAY-IN-THE-LIFE  
3.9 LIFE CYCLE ASSESSMENT (LCA)  
3.10 ECONOMIC ASSESSMENT  
3.11 PRODUCT DEVELOPMENT AND MARKETING

## SECTION 4. SUMMARY

## SECTION 5. REFERENCES
SECTION 1  EXECUTIVE SUMMARY

The Toll Pass System (TPS) will be the updated replacement of all of the toll areas on all of the toll roads in the country. We believe that it will have beneficial effects on the highway system and consumers using this product. Our product focusing on all three categories: Safety, Green, and Connectivity. The current system involves massive toll booths to use the EZ Pass at a slow speed, causing traffic if a large influx of vehicles are on the road increasing harmful emissions in the immediate area. This system will allow vehicles to pass through without needing to sacrifice speed and therefore, reducing the chance of accidents on the road, also reducing harmful emissions that traffic causes in a given area. In addition, the Toll Pass System will be connected to online accounts that are wired to one’s bank account for transactions more efficiently, as it is common that sometimes the EZ Pass does not register on the overhand tag readers. Our product effectively reduce that risk with the TPS, which is more efficient than the current system.
SECTION 2 INTRODUCTION

2.1 PROJECT OBJECTIVES. Identify technologies and opportunities to make motor vehicles safer, greener, and more connected.

2.2 PROJECT BACKGROUND. There are up to 50 computers buried beneath the skin of the cars and trucks that you every day on the road. You wouldn’t know they were there. But each of them is making that vehicle safer, greener, and more connected. Many of those computers were designed and built by Delphi. It seems every day we’re hearing in the news about “cars of the future”, ones that will park themselves, drive themselves, talk to us, use fuel more efficiently, report data to insurance companies, avoid accidents, etc. What does this mean in terms of the technologies needed, societal acceptance, and the policies and supporting systems needed to enable these safer, greener, more connected cars and trucks?

2.3 SPONSOR BACKGROUND. Design engineering and manufacturing solutions to respond quickly and efficiently with localized program support for major products including Engine Management Systems, Fuel Injection Systems, Ignition Systems, Alternative fuel management systems Electronics and Safety. Delphi is working to create safer driving conditions which incorporate information, entertainment and connectivity to enhance the driver’s experience. Delphi’s safety expertise involves everything from crash sensing electronics to collision mitigation. Utilizing their radar, vision, and vehicle-integration experience, they’re enabling innovative safety systems that help make advanced safety features affordable in the mainstream vehicle market. These systems are designed to support their vision of a society with zero fatalities, zero injuries, and zero accidents. Delphi’s product focus encompasses Engine Control Module, Advanced reception systems, Navigation, displays, adaptive cruise control, radar and camera systems, and parking guidance systems. Their thermal systems meet customers’ heating and cooling needs across all sectors, with products that provide world-class comfort. They’ve been managing air, liquids, and temperature longer than any other automotive supplier in the world and were the first to integrate electronics, sensors, and special algorithms into climate control systems to make them smarter, faster and better than ever before.
2.4 PROJECT CATEGORIES. Delphi has three major target areas in which they want to approve on. These three categories are Safe, Green, and connected.

Safe: Delphi’s main concern is for the safety of their customers. They are striving to make their vehicles advanced enough to be able to evade crashes altogether.

The safety of the driver and the passengers is the pinnacle priority. Airbags are one example on how this could help the riders once the car has crashed. The future technology for safety features are moving toward sensors on the car that can detect when a crash is going to happen and warn the driver or even take control over the car to prevent a crash in the first place.

Green: Delphi is striving to help make a world with zero emissions.

More and more vehicles are being made that are either hybrid or electric. However, Delphi is looking for other fuel sources, how to make the car lighter so it would use less fuel, or to make the engine run more efficient.

Connected: Delphi is exploring what the customer is looking for, and that is to be connected.

Being connected will help the driver avoid distractions such as talking on a cell phone. Another way to look at being connected is having technology that can find where there is traffic on the route the car is taking and to reroute the car around the traffic in order to get from place A to place B the fastest.

2.5 PROBLEM STATEMENT. Currently toll booths are viewed as being too slow and time consuming. Our device will prevent congestion, reduce time at tolls, and save the consumer money. Our system incorporates all Delphi project categories. It will reduce traffic which will prevent crashes, reduce emissions by allowing cars to move at higher speeds, and be more connected through the internet to each EZ pass account to accurately track toll costs.
SECTION 3 METHODOLOGY

3.1 PROPOSED DEVICE. Our device is a small box that will house a more powerful EZ Pass that will be able to easily connect to the tag reader at higher speeds. Also, the driver will be able to easily input the serial number into the Toll Pass System (TPS) website or app via computer or smartphone that will register the car to the system. On this website or app, the customer can input their information and payment method. The TPS will be built into the roof of the car or it can be attached to the roof for market testing or for people who already have a car.

3.2 RATIONALE FOR SELECTION. There is a definite need in society for a device that lets cars travel through tolls easily and effectively. The widely known EZ Pass is a good alternative, but it has its issues. There is also a health hazard near areas that have tolls near them, that can be avoided through the new system. It has been found that there is an increase in infant prematurity (about 6-9%) in areas that have tolls near them. The slowing and sometimes stopping of cars and an increase in traffic congestion causes a much higher pollution rate in these areas. The new TPS will cut down on pollution because it will allow traffic to flow smoothly as it normally would.

3.3 CUSTOMER NEEDS. Toll booths are notorious for slow, inefficient service. They can quickly fill up and create dense traffic which is frustrating for drivers and bad for cars. When cars slow down for the tolls they have a reduced gas mileage, creating an unhealthy environment and additional costs to drivers. Drivers who try to avoid these troubles by using the EZ pass system experience problems of their own. Many are over charged by EZ pass and are still required to slow down considerably. Our EZ pass system seeks to create wider EZ pass lanes and better sensors so cars can travel uninhibited at higher speeds. By travelling at higher speeds, cars would have increased fuel mileage saving the driver money. Likewise, cars at high speed will produce less emissions and create less congestion. The sensors would only turn on within a specific radius around the toll booth prevent unnecessary charges to EZ pass accounts.
3.4 OBJECTIVES AND GOALS. The objective of the TPS is to increase safety and efficiency for motor vehicles and people. It should be able to greatly increase the efficiency of cars going through a toll area and the efficiency of paying for the toll. The goal is to cut down on pollution and traffic congestion around toll areas and increase the health of these areas. Another goal is to get the product backed by the government to make it a mandatory addition to every car. This would make every toll area safer and more efficient.

3.5 CONCEPT OF OPERATION. Our EZ pass system will utilize a small, square device placed on the top or rear of the consumer’s car. This device will be connected to an EZ pass account so that the user will be appropriately charged when passing through an EZ pass toll.

3.6 SYSTEM CONTROLS. The Toll Pass System (TPS) is only be controlled and activated when the toll booth tag readers will be in range of the TPS. Once the car is in range of the tag readers on the toll booth, the radio-frequency emitted from the tag reader activates the transponder inside the TPS. Then the transponder will send a signal back into the reader with the serial number which contains basic account information, which then is sent into the central database for documenting. If the account is in good standing, a toll is deducted from the driver’s prepaid account. If the toll lane has a gate, the gate opens. A green light indicates that the driver can proceed. Some lanes have text messages that inform drivers of the toll just paid and their account balance.
3.7 SYSTEM MODEL.

Figure 1: Toll Pass System (TPS)

Figure 2: TPS Positioning on Car
3.8 **DAY-IN-THE-LIFE.** A typical day in the life of our device would include driving through an EZ pass toll and having the signal connect to the tag reader. It would then send information including the driver’s identification number, so the toll can be deducted directly from the driver’s account.

3.9 **LIFE CYCLE ASSESSMENT (LCA).** The Toll Pass System’s outer surface will mostly be composed of aluminum, or recycled aluminum if requested, because it will be installed on top of the vehicle instead of inside the vehicle. Distributing this device will be convenient for those wishing to purchase them before it will be required to be installed with the vehicle when a customer’s purchases a new one. Major electronic stores, such as Best Buy and Radioshack, along with the Department of Motor Vehicles and car dealerships. Soon, newer models of vehicles in a wide range of companies will have the device already implemented into the car and cost into the final bill. Using this device will promote less congestion of vehicles at toll booths to reduce car emissions in a given area, therefore not polluting the surrounding area. Since the device has simple minimal electronics, and a simple casing of aluminium, the device can easily be modified or replaced due to the abundance of materials needed to repair the device. The TPS should repair minimal maintenance as it is based off the current model of the EZ Pass, so problems with its functions will be rare and the customer doesn’t need to constantly check the device. The contents of the Toll Pass System can be recycled without delay to build more devices or be used as repair components because it is composed of aluminum and simple electronics.

3.10 **ECONOMIC ASSESSMENT.** An AACE class 5 level cost estimate for our device is in between $10 and $30. We have looked on the cost of the normal EZ Pass to be around $35 new. Since the size is relatively the same, if not smaller, it will cost less to produce the shell but slightly more for the interior, since the electronics will be more efficient and stronger than the current model. When the device is finally integrated into the vehicle, most likely it would need to be updated to follow suit with developing technology. Once the TPS is released, it will need to fit the demands of the customers and meet their satisfaction and expectation of our proposed device.
3.11 PRODUCT DEVELOPMENT AND MARKETING. Delphi will work with the government owned roads to put in tag readers in a lane of the tollbooth so that cars will be able to travel at highway speeds and the tag reader will still be able to read the signal. Testing of this product would include driving at high speeds to see what the maximum speed a car can travel at while still being able to have the signal read. The market testing process will include setting up the new tolls in some areas and advertising the new TPS as an alternative to the E-ZPass. The charge for this market testing will be between $10 and $30. We would expect that once the product is fully released it will be bought in the hundreds of thousands especially if the government backs it. Since the target audience is anyone who drives there will be no advertising directed at a specific age group. Instead advertisement will be focused on safety and efficiency.
SECTION 4 SUMMARY

Our TPS system would allow cars to cross tolls faster and avoid traffic. This would lead to reduced emissions and increased gas mileage. It could be easily utilized by automakers due to its small size and need for little power. The device could easily be built into the car or sold in a retail setting. Some disadvantages to our device include having to alter/update equipment currently installed at toll booths. Additionally, the system relies on large numbers of people using EZ pass to reach the desired results of less traffic (if a majority still use conventional tolls traffic will still build up behind the station). However, we believe our device is a worthwhile investment to those who frequent toll booths as it will make trips much faster and less of a hassle. Its compact size also makes it easy to fit onto any vehicle.