Team members:

Project Manager: Jake Bosio
Security Manager: Chandler Drake
Customer Liaison: Andrew Haakenson
Artifacts Manager: Sadeem Boji

Customer: Mr. Anthony Torre, Besser Systems and Software LLC

Instructor: Dr. Betty H.C. Cheng*

*Please direct all inquiries to the instructor.
Team Members

Project Manager
Jake Bosio

Artifacts Manager
Sadeem Boji

Security Manager
Chandler Drake

Customer Liaison
Andrew Haakenson
Project Overview

- Electrical Power Assisted Steering
- Assist driver by increasing or decreasing torque on the steering wheel
- Normal Control and Wheel Angle Closed Loop Control
- Consistent and safe steering feedback
Overview of Features

- Normal Control
- Wheel Angle Closed Loop Control
- Error protocols
- Safe shut down
- Diagnostics
Domain Research Overview

- Investigated common industry practices and standards for current electric power steering systems
- Applied the electric power steering domain knowledge to ensure a safety critical and future-proof system

Project Constraints
- Hardware Designs
- Software Assurances
- Cybersecurity Features

GM power steering recalls

Software & Hardware

- Reserved Processor
- Mode Switch Timings
- Redundant Circuits
- Override switch
- Diagnostics
- Controller Area Network

Torque Assist

Image Source:

Ackermann Steering

Image Source:

Discrete Override Switch
Cybersecurity Features

- Advanced Encryption Standard
- Authorize Diagnostic Technicians
- Bit Flip Preventions
- Phase Out Updates

Bit Flip Representation

Original Bit: 0

Flipped Bit: 1

EPAS Controller → AES → Packet Verification

Packet Representation
EPAS Controller State Diagram

- Calculate Normal Mode power steering and send value
- Calculate power steering
- Get Sensor Data
- Start New EPAS Calculation

- Encrypt
- In Diagnostic Mode
- Send Data to Diagnostics

- Not in Diagnostics Mode
- Apply Motor Force
- Sent Packets Agree Wheel Sensor Not Stuck

- Wheel Sensor Prevented from Turning to Calculated Value

- Send EPAS with 5% more force
- Sent Packets Agree
Autonomous Driver Assist System (ADAS)

- **System Ready**
  - Vehicle On

- **Check EPAS Controller for Message**
  - check for messages / [shutdown == false]
  - enableADAS / [adasOn]
  - check for potential response to message
  - Send Message to EPAS Controller

- **ADAS Active**
  - disableADAS / [adasOff or criticalError or driverDisabled or shutDown]
  - error detected / [speedError or wheelAngleError]

- **ADAS Inactive**
  - vehicle shutting down / [shutdown]
  - Vehicle Off
Part III: Demonstration

- The input screen supports entering values for the torque sensors and vehicle speed. It also has functionality for enabling different parts of the system.
- The output screen displays the results of the input screen by showing how much the wheels rotate and the reason behind it.
Scenario 1: Working as Intended

Videos can be found at https://drive.google.com/drive/folders/1M4fdbQrxNuQTXYaVD-Cdv1oyM1hDe2hD?usp=sharing
Scenario 2: Reducing Number of Torque Sensors

Videos can be found at https://drive.google.com/drive/folders/1M4fdbQrxNuQTXYaVD-Cdv1oyM1hDe2hD?usp=sharing
Scenario 3: Switching Modes

Videos can be found at https://drive.google.com/drive/folders/1M4fdbQrxNuQTXYaVD-Cdv1oyM1hDe2hD?usp=sharing
Acknowledgements

• We gratefully acknowledge and appreciate the participation of our customer, Mr. Anthony Torre from Besser Systems and Software LLC
Thank you for listening to our presentation.

Feel free to ask any questions you have.