ADVANCED INSTRUMENT CLUSTER THESIS

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in

Automotive Domain

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Advanced Instrument Cluster Development with Odometer and Speedometer Using STM32H735IG-DK

Abstract:

The objective of this project is to address the complexities and inefficiencies of managing multiple controllers for odometers and speedometers in automotive applications by utilizing the STM32H735IG-DK microcontroller. Traditional setups often face compatibility issues, data synchronization problems, and processing inefficiencies leading to inaccurate readings. The STM32H735IG-DK microcontroller, with its high-performance cores and integrated peripherals, offers a unified platform that simplifies system design, enhances performance, and ensures accurate real-time data processing for odometers and speedometers. Additionally, the project integrates features such as Trip A and Trip B readings, customizable display layouts, and warning indicators to enrich the functionality of the instrument cluster.

Introduction:

The development of an advanced instrument cluster is essential for modern vehicles, providing drivers with critical information such as speed, distance traveled, and various warnings. The STM32H735IG-DK microcontroller is leveraged in this project due to its robust computing capabilities, extensive peripheral support, and suitability for automotive applications. This microcontroller is pivotal in processing sensor data, calculating distances, and determining the current speed of the vehicle. The project involves both hardware and software components, including the use of STM32CubeIDE and STM32CubeMX for peripheral configuration and initialization code generation. The graphical user interface (GUI) for the instrument cluster is designed using TouchGFX, enabling the creation of dynamic and visually appealing displays.

Overview of Instrument Cluster:

An instrument cluster, commonly referred to as a dashboard, is an integral part of automotive vehicles, providing essential information about the vehicle's status and performance. Modern instrument clusters often feature digital displays that replace traditional analog gauges, offering enhanced customization, improved visibility, and additional functionalities such as navigation and entertainment controls. The cluster communicates with various vehicle systems through interfaces like the Controller Area Network (CAN) bus, ensuring seamless integration and data exchange.

STM32H735IG-DK in Automotive Applications:

The STM32H735IG-DK development board is chosen for its high-performance computing capabilities, featuring Arm Cortex-M7 and Cortex-M4 cores that efficiently handle complex algorithms and real-time data processing. The microcontroller's rich set of peripherals, including ADCs, timers, and communication interfaces, is crucial for interfacing with sensors and other vehicle systems. Integrated hardware acceleration for GUIs makes it suitable for developing visually appealing instrument cluster displays. The development ecosystem provided by STMicroelectronics, including STM32CubeIDE and STM32CubeMX, streamlines the development process, enhancing the design, prototyping, and debugging of automotive applications.

Proposed Solution:

The project proposes the development of an advanced instrument cluster using the STM32H735IG-DK microcontroller to integrate odometer and speedometer functionalities. The solution involves interfacing the microcontroller with sensors such as wheel speed sensors and odometer sensors to accurately monitor vehicle parameters. The cluster features customizable display layouts, warning indicators for critical vehicle conditions, and integration with other vehicle systems. The high-performance cores of the STM32H735IG-DK ensure accurate and synchronized readings, addressing the challenges of compatibility, data synchronization, and processing inefficiencies.

Implementation and Results:

The implementation process includes setting up the STM32H735IG-DK microcontroller, configuring system components, and developing the GUI using TouchGFX. The sensor setup involves integrating a Hall sensor to measure the vehicle's speed and distance traveled accurately. The project successfully demonstrates the real-time processing capabilities of the STM32H735IG-DK microcontroller, providing accurate and synchronized readings for the odometer and speedometer. The customizable display layouts and warning indicators enhance the usability and functionality of the instrument cluster.

Conclusion:

The development of an advanced instrument cluster using the STM32H735IG-DK microcontroller addresses the challenges of managing multiple controllers for odometers and speedometers in automotive applications. The project demonstrates the microcontroller's capability to provide a unified platform that simplifies system design, enhances performance, and ensures accurate real-time data processing. The integration of additional features such as Trip A and Trip B readings, customizable display layouts, and warning indicators further enriches the functionality of the instrument cluster, contributing to improved driver safety and vehicle performance.