ZKW Lichtsysteme GmbH

Intelligent Lighting Systems for the Next Generation of Vehicles

speedgoat
real-time simulation and testing

Engineers at ZKW Lichtsysteme GmbH are using Speedgoats' Mobile real-time target machine and Simulink Real-Time™ to rapidly design and in-vehicle test innovative control algorithms for sophisticated LED headlamp projection technology changing illumination dynamically.

ZKW Lichtsysteme GmbH specializes in innovative and premium lighting systems and electronics for future generations of vehicles. As a systems supplier, they are one of the world's leading strategic partners to the automotive industry, designing and producing state-of-the-art lighting and electronic modules.

Project Description

ZKW is developing a complex projection technology for headlight systems, changing illumination dynamically. It is based on the individual control of a high number of LEDs, which are placed in a specific geometric order. Each of the LEDs has its own specific illumination space, and the combination of all spaces results in the whole light distribution.

This technology for headlight systems enables the functionalities needed for an adaptive driving beam containing an advanced front lighting system (AFS) and a glare-free high beam (GFHB).

Also, a bending light is possible by dynamic control of the LEDs, which emulates the mechanical swiveling of the whole light distribution.

All software algorithms, structured as flexible modules, are eventually running on an ECU placed outside the headlamp. Core software modules are used for controls and to perform low-level tasks such as interfacing with all the LEDs.

To meet new customer requirements, one of these software modules had to be developed from scratch. The new module needs to read signals for requested beam patterns, the swiveling angle, and, if applicable, the target positions for glare-free high beam areas.

With this information, it periodically calculates the current dimming value for each of the addressable LEDs in the projection system. It can, therefore, realize an adaptive and dynamic change of light over time.

To develop a prototype "on the fly," ZKW realized that using manual coding in C was not the right approach. What they needed was a flexible prototyping development platform, where they could easily adapt, test, and tune new control designs. Therefore, they chose to use Speedgoats' Rapid Control Prototyping platform, which enabled them to use Simulink to model their control algorithms and to easily deploy automatically generated code from the model to the Speedgoat target machine.

ZKW engineers using the Mobile real-time target to run their models efficiently.

The Mobile real-time target machine was chosen for the deployment of the prototype within a dedicated test vehicle. To connect the target machine with the vehicle network, ZKW engineers implemented a gateway via CAN by leveraging the provided Simulink CAN interface blocks from Speedgoat.

This gateway was needed to receive pivotal input signals such as requested beam pattern, swiveling angle, and glare-free areas, which are derived from the vehicle dynamics, lighting requests, and camera signals. These signals were fed back to the model by using the available Speedgoat driver blocks.

ZKW deployed the Simulink model as a standalone application onto the target machine. Finally, the Mobile real-time target machine was put into the development vehicle to connect the headlamp and to control the individual LEDs.

During night drives, the rework of the model was mostly done via local simulation, followed by an update of the standalone application.

Another benefit of using Speedgoats' solution was that ZKW engineers were able to easily access recorded data and visualize it to evaluate how changes in the control algorithm lead to the targeted improvements.

"Model-based design itself has proven to be very flexible, powerful and efficient for our purposes. Using the Mobile real-time target machine from Speedgoat, we were able to completely redesign a functional prototype based on a model and verify it during an afternoon session."

Matthaeus Artmann, Manager Electronics Engineering Pre- and Module Development, ZKW Lichtsysteme GmbH

Benefits of Model-Based Design

According to ZKW, one of the most significant advantages of using Speedgoat and MathWorks products was that they could adapt and deploy algorithms within hours instead of days, saving them a significant amount of development time. Furthermore, automated code generation using Simulink Coder™ eliminated the risk of code errors.

And the powerful real-time hardware system from Speedgoat provides enough processing resources, enabling ZKW engineers to further develop and optimize their algorithms without needing to worry about having enough computing power.

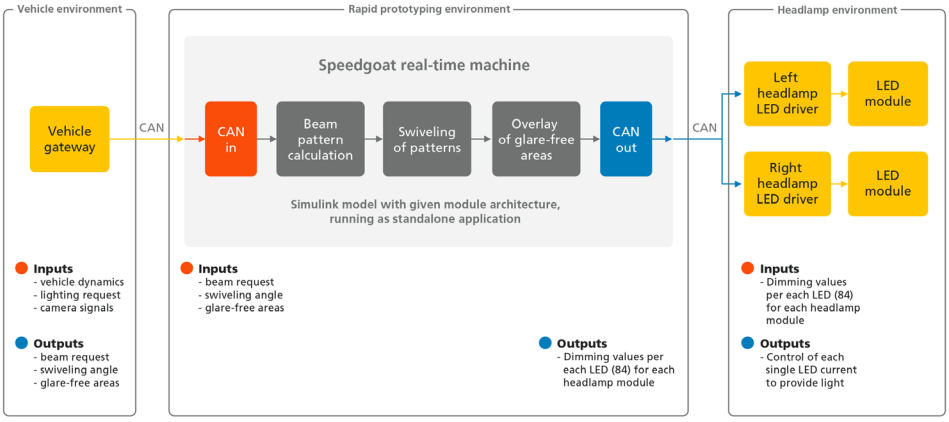
Going Forward

In the future, ZKW is considering using a Mobile real-time target machine to cover the utilization of different sensors in other development vehicles to identify the capabilities of sensor fusion for adaptive front lighting.

The sensor will be connected via Ethernet using TCP/IP packets, and Speedgoat's Mobile real-time target machine will serve as the control of the headlamp system.

With this setup, ZKW wants to extract information about object and vehicle environment information for the headlamp system to function in an even more dynamical way.

The ZKW System Setup



Utilized Speedgoat products:
» Mobile real-time target machine
» IO601 CAN I/O module

Utilized MathWorks products:
» MATLAB®
» Simulink®
» Fixed-Point Designer™
» MATLAB Coder™
» Simulink Coder™
» Simulink Real-Time™

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