Western Digital.

CASE STUDY

Real-Time Driver Monitoring Systems Require a Robust Storage Solution

PATHPARTNER

Challenge

- A large amount of quality data needs to be captured, stored and processed for real-time driver monitoring systems
- Reliable performance is required under different driving conditions
- Need a scalable storage solution

Solution

- Western Digital iNAND® IX EM132 EFDs
- NXP IMX 8X™ based processing unit
- OmniVision OV2311 camera sensor

Key Results

- Effective monitoring and alerting of signs of drowsiness and distraction
- Real-time on-field data collection for algorithm improvement and better fleet management

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Company Profile

PathPartner, headquartered in Bangalore, India, specializes in product engineering, providing concept-to-production services to customers across automotive, consumer electronics, broadcast, medical and the internet-of-things domains. Through innovative technologies built around deep learning, computer vision, multimedia, imaging, and internet of things, the company enables customers to solve complex business challenges. The comprehensive portfolio of services coupled with state-of-the-art technology building blocks provides customers with advantages of top-of-the-line technologies, superior performance and faster time to market.

Another Pair of Eyes for Safer Roads

Distracted driving is dangerous. Every day about eight people in the United States are killed in crashes that are reported to involve a distracted and/or drowsy driver[1]. By scanning facial expressions and retinas, a Driver Monitoring System (DMS) can detect a driver's wandering eyes, slow eyelid closure, head nodding, and his or her emotions under various operating conditions. The DMS is able to evaluate the driver's state of vigilance and send a warning when signs of inattentiveness, fatigue or distraction are detected. For these reasons, driver monitoring is considered an essential component in the development of autonomous driving systems. In semi-autonomous vehicles, such as Level 3 automotive autonomy, drivers are allowed to take their hands off the wheel but still must keep their attention on the road in case the vehicle needs human override. The DMS can trigger alerts to the driver and initiate an intervention to take control of the vehicle to prevent potential accidents from occurring.

AI at the Edge

Western Digital and PathPartner have collaborated with a customer who develops full-stack self-driving technology to enable large-scale autonomous commercial fleets. The customer required a reliable and ready-to-use solution for a range of in-cabin driver status monitoring applications.

To meet the customer's requirements, PathPartner offered a high-performance and cost-effective solution. By attaching a camera module—OmniVision's OV2311 camera sensor with NIR illumination to NXP's IMX 8X-based processing unit via a high-end automotive-grade FAKRA connector—the system enables reliable performance under different lighting conditions and monitors drivers around the clock in real time using eye, yawn, head and blink statistic-based fatigue prediction and face recognition. Coupled with advanced facial analysis algorithms and deep learning models, the DMS are able to assess the driver's alertness and send real-time audio and LED flash warnings when drowsiness or distraction are detected. Real-time processing and detection are made possible through advanced AI. These systems have been successfully deployed in thousands of commercial trucks.

"We have been working with Western Digital on two of our offerings: Driver Monitoring System and PT605 SoM. The embedded flash memory devices from Western Digital play an indispensable part in both of our products. Product compatibility, superior technology, and excellent technical support have allowed us to provide the best-in-class products to our customers."

—Varun Bramhananda, Project Manager

"It's worth noting that AI-enabled on-device intelligence and machine learning require more and deeper data. By partnering with Western Digital, we can leverage its complete product portfolio and adapt to different customer needs quickly and efficiently. As our DMS are becoming feature-rich and more accurate, the memory requirements keep changing, too. Western Digital's role and support here is indispensable."

—Vinay MK, VP of Engineering

Fueled by Data

To provide complete visibility of driver behavior, the camera is designed to operate at an average of 8–10 hours per day. The sensor continuously captures high-quality video of up to 60 frames per second (fps) in 1600 × 1200 resolution. (PathPartner is working on increased resolution for future systems.) On-field alerts and events are recorded as video clips, stored locally and later uploaded to the cloud when network conditions allow it, for further evaluation with the aid of complex computer vision algorithms. Both the machine learning model for face detection and land-mark regression, and the shallow and deep Convolutional Neural Network (CNN) model for estimations and classifications rely heavily on large amounts of high-quality data to measure and analyze head pose, eye movement, and other facial features. With a 3- to 5-year expected lifespan, it is critical to determine the exact amount of storage and endurance the system will require.

PathPartner has engaged with Western Digital to ensure the efficiency of on-field data collection and the long-term reliability of the database for algorithm improvement. Storage experts from Western Digital conducted thorough workload analysis and helped the customer optimize their data utilization. Featuring advanced flash memory management firmware that provides enhanced power immunity, Error Correction Code (ECC), wear leveling, and bad block management in a small physical footprint, Western Digital's industrial-grade iNAND® IX EM132 Embedded Flash Devices (EFDs) were selected for the DMS.

Data-intensive applications, such as DMS, can use industrial-grade e.MMC EFD products to capture every critical moment, log each event, and ensure high quality of service.

Western Digital's industrial-grade iNAND IX EM132

Western Digital, through its wide and diverse storage solutions portfolio which includes iNAND e.MMC and UFS product lines, removable cards and NVMe™ SSDs, offers business scalability and flexibility across a variety of storage needs. In the following phase, PathPartner plans to deploy a multi-camera setup and integrate the DMS with in-cabin sensing.

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[1]National Highway Traffic Safety Administration. (April 2020.) Traffic Safety Facts Research Note: Distracted Driving 2018. Department of Transportation, Washington, DC: NHTSA. Accessed 18 August 2020.