Success Story

Road to the Final

VDL Robot Sports Recruit AAEON's BOXER-8651AI to Tackle RoboCup 2024

Focus: AMR
Product: BOXER-8651AI

Introduction

The RoboCup is an annual competition in which technological collaboration meets sport. The initiative, first held in 1997, serves as a platform to inspire and showcase innovations in autonomous robotics through the world's most popular sport, football. An open industrial team made up with industry professionals from various high-tech companies in the Dutch Eindhoven region, VDL Robot Sports has been fielding a team of autonomous robotic systems for a sizable portion of the competition's history, competing in the competition's Middle Size League (MSL).

For RoboCup 2022 and 2023, held in Portugal and France respectively, VDL Robot Sports made use of AAEON's BOXER-8251AI, featuring the NVIDIA® Jetson Xavier™ NX. For 2024's competition, held in the Netherlands, VDL Robot Sports decided to upgrade their platform to capitalize on the innovations AAEON's AI@Edge Solutions range had made during the intervening period, selecting the BOXER-8651AI as the system to help elevate their team's performance to the next level.

Tackling Development Challenges

Developing a 'team' of five autonomous robots able to play football as a cohesive unit came with a range of considerations. The robots had to be able to navigate a dynamic, fast-paced sporting environment, process vast volumes of data from multiple sources in real-time, and execute actions based on tactically sound split-second decisions.

As such, VDL Robot Sports required a system with a variety of interfaces able to accommodate sensors, cameras, and actuators to facilitate the data acquisition necessary to perform these actions. Another question was whether the system had the capacity to run complex AI software leveraging NVIDIA JetPack™ along the main robot software for decision making and tasks execution.

Less technical but just as important was how suitable the environmental specifications of VDL Robot Sports' chosen system was to their autonomous robotic systems. Given that the robots would encounter fast, omnidirectional movement, the chosen system would need to be both robust enough to handle such use and small enough to allow the robots to move in a dynamic and agile way.

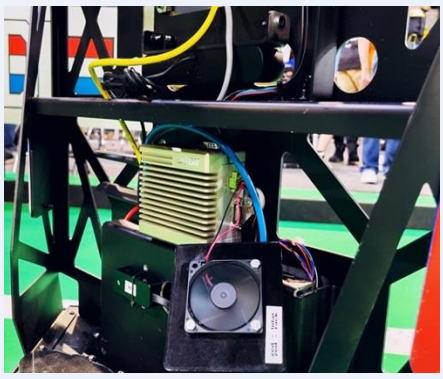
The BOXER-8651AI - VDL's SuperSub

Key reasons for the client choosing the BOXER-8645AI to power their autonomous passenger transport vehicle was its unique combination of GMSL2 camera support, its ability to run extremely detailed AI inference models, and its rugged mechanical design.

The Team's Playmaker: NVIDIA® Jetson Orin NX Inferencing Power

When it came to meeting the expectations of VDL Robot Sports' autonomous robotic system, AAEON's BOXER-8651AI hit the back of the net. Featuring the NVIDIA® Jetson Orin NX, the BOXER-8651AI provided was on target, with the integrated NVIDIA Ampere GPU featuring 1024 CUDA® and 32 Tensor Cores offering exceptional inferencing capabilities. Moreover, the system supported the NVIDIA JetPack™ software development kit, allowing the engineers at VDL Robot Sports to optimize the performance of their AI models, including the use of TensorRT for high-performance deep learning inference and CUDA for parallel computing.

The team trained their model using YOLOv5 with transfer learning, achieving high recall and precision. They then converted it to ONNX format and optimized it using NVIDIA TensorRT. This allowed the robots to complete visual recognition tasks such as detecting and tracking the ball, distinguishing between their robotic team members and opponents, and identifying goalposts.



Application Story

These AI models and algorithms were integrated into their main robot software, wherein sensor data was introduced and analyzed using the respective AI models. The results of this analysis were used to make real-time decisions and control the robots' actions.

The BOXER-8651AI's NVIDIA® Jetson Orin NX, with its powerful NVIDIA Ampere GPU, enabled high-speed inference of the models employed by the team, reducing latency when the robots were required to perform complex visual and strategic tasks

The Box-to-Box Midfielder: The BOXER-8651AI's Communication Interfaces

To connect the cameras and the other MCUs managing the various sensors and actuators, VDL Robot Sports' autonomous robotic system leverage multiple interfaces available on the BOXER-8651AI.

Key to the operation of the robots was the use of the BOXER-8651AI's dual USB 3.2 Gen 2 ports, through which a stereo camera, necessary for obtaining visual data, crucial for mapping and obstacle detection, were integrated.

The Ethernet interface was used to communicate with the other MCUs which are controlling the various sensors and actuators of the robot.

While VDL Robot Sports trusted their robot counterparts to get the job done on the field, communication is key to success in every team sport. As such, the team utilized the BOXER-8651AI's M.2 2230 E-Key slot for Wi-Fi expansion, allowing for communication between the robots and the coaches on the sidelines.

Maintaining Defensive Solidity: Compact, Environmentally Resilient Hardware

The environmental robustness and compact, lightweight design of the BOXER-8651AI made it ideal for installation as part of the VDL Robot Sports' autonomous robotic systems, particularly with respect to size limitations and the ability to withstand the dynamic movement of the robots during matches.

Application Story

At just 105mm x 90mm x 52mm, the BOXER-8651AI's dimensions ensured it did not take up a substantial amount of space within the larger mechanical design of VDL Robot Sports' autonomous robotic systems, allowing for the necessary motors, actuators, and sensors to be accommodated. Further, the PC's net weight of 1.58 lb. minimized the strain that the BOXER-8651AI had on the robots' mobility, maneuverability, and speed. Additionally, the BOXER-8651AI's anti-shock and vibration resistance features further enhanced its durability and reliability, given the frequent changes in direction it faced throughout games.

These features ensured that the system could withstand the physical stresses and environmental variations encountered during competitions, while its compact size and light weight facilitated seamless integration into the robots, preserving their mobility and effectiveness.

Post-Match Report

The transition from AAEON's BOXER-8251AI to the more advanced BOXER-8651AI had a substantial impact on VDL Robot Sports' performance during the 2024 RoboCup MSL. The advanced capabilities of the BOXER-8651AI helped the team produce a truly breathtaking example of what can be done in the field of autonomous robotics, a field bound to attract the eyes of the next generation of engineers.

Having progressed through the competition with notable wins over the likes of Robot Club Toulon, VDL Robot Sports fell at the final hurdle, losing to eventual winners Tech United in the semi-finals. Despite this, the event can be considered an enormous success, with a number of dramatic contests, fantastic sportsmanship, and the convergence of some of the world's greatest minds in autonomous robotics research.

Discover more from VDL Robot Sports with the online presentation showing the low-cost fast mobile object detection for robotic soccer that won the first place in the scientific challenge world championship 2021 MSL here.

.

About AAEON

Established in 1992, AAEON is one of the leading designers and manufacturers of industrial IoT and AI Edge solutions. With continual innovation as a core value, AAEON provides reliable, high-quality computing platforms including industrial motherboards and systems, rugged tablets, embedded AI Edge systems, uCPE network appliances, and LoRaWAN/WWAN solutions. AAEON also provides industry-leading experience and knowledge to provide OEM/ODM services worldwide. AAEON works closely with premier chip designers to deliver stable, reliable platforms. For an introduction to AAEON's expansive line of products and services, visit www.aaeon.com.

Follow Us

Contact Us

AAEON Technology Inc.

6F., No. 28, Baogao Rd., Xindian Dist.,
New Taipei City 231029, Taiwan R.O.C.

+886-2-8919-1234

www.aaeon.com