



LocoLabs

Case Study: Industrial Robotics DVDPlay Rental Kiosk (Redbox/NCR)

DVDPlay had a problem. Although their concept of a DVD rental kiosk was revolutionary, and they had a software application in development, their hardware prototype was giving them trouble. The kiosk contained complex robotics with servo systems to transport DVDs. The system worked fine for a short period of time, but eventually it lost calibration and began functioning erratically. Jens Horstman, DVDPlay's CTO, called up LocoLabs to see if we could help. Brad Hoffert and Steve Kelsey, founders of LocoLabs, have extensive electrical engineering backgrounds. They quickly identified issues within the power subsystems and noise which were affecting control logic in the system.

Find and Fix an Existing Problem

Rather than theorize about the many issues that could contribute to the erratic behavior, we realized we could quickly isolate the problem and get the system working again utilizing a USB control technology module that LocoLabs had developed previously. We were able to isolate control of the servo subsystems from the digital control and quickly identify the calibration issue. DVDPlay, excited by the results we achieved using the technology module, asked us to design an intelligent embedded control board based on the same technology. With the module as a head start, LocoLabs quickly delivered the control board and provided firmware to control the system with a solidly defined API.

Next-Generation System

LocoLabs successfully leveraged its USB technology module to get DVDPlay's prototype systems working reliably and to produce the first line of 100-disk DVD rental kiosks deployed in the field. Due to the popularity of the first kiosks, a new 500-disk kiosk was proposed. The design called for two additional high-speed servo axes, which would push the limits of the original power. DVDPlay again turned to LocoLabs. This challenge: Upgrade the 100-disk system to 500 disks and maintain the quality and reliability standards necessary for much higher volume production. The LocoLabs engineering team developed a robust system featuring optically isolated control, isolated motor power, and single-point grounding to minimize the effects of the additional motor noise and assure reliable long-term operation. Recognizing that volume manufacturing would require automated calibration, we included flexible control logic and headers to support a future calibration tool.



Virtual Environment Upgrade

With the growing complexity of the software code needed to control the 500-disk system, another challenge arose. For the early 100-disk kiosk, control firmware was developed almost exclusively in a high-level language running on a small executive on a small MCU. This allowed for rapid development based on the USB technology module libraries. As the 500-disk, 3-axes system developed, the increased code base pushed the limits of the MCU, slowing firmware development. DVDPlay needed a quick-time-to-market solution that would eliminate the need to upgrade the MCU, while keeping firmware development on schedule. LocoLabs came to the rescue with virtual machine technology. We were able to separate the application code (for running and testing) from the low-level hardware drivers. With the Virtual Machine Compiler, the code could be compiled down to a size that would efficiently fit in the existing hardware, while increasing the system's capabilities, features, and flexibility.

Manufacturing and Test Fixturing

Building a single complex system such as the DVD rental kiosk, with over 1000 parts and multiple large subsystems from multiple vendors, is a complex task. Building hundreds of these systems a month to meet the customer demand was a daunting task for DVDPlay. LocoLabs worked side by side with DVDPlay to build their first production systems and bring up their manufacturing line. LocoLabs understood that building and testing the entire system as a whole would be too time-consuming. So we built specialized test fixtures for individual subsystems, allowing subsystems to be programmed and tested before they were integrated into the larger system. Calibrating complex robotic systems can also be a time-consuming production task. Due to required tolerances in mechanical fixtures and servo motors, each unit had to be calibrated by hand before it could be tested and shipped. LocoLabs developed an automated calibration system utilizing precise sensors and calibration software. The auto-calibration tool allowed the manufacturing team to speed production; technician time and human error were eliminated from the calibration process. Another benefit: service calls could be conducted by fewer technical personnel.

■ DVDPlay revolutionized the movie rental industry with its DVD rental kiosk. DVDPlay was the underlying system that evolved into Redbox.

“DVDPlay turned to LocoLabs to solve some vexing calibration problems with our early kiosk prototypes. LocoLabs quickly diagnosed the issues and delivered a solution. Impressed, we brought on the Loco team to add features and improve the overall robustness of the systems. LocoLabs ended up delivering all embedded robotics control firmware, electronics, sensors and power systems design, and a solid manufacturing platform – this allowed us to focus on customer interface, billing systems, and field deployment.”

Jens Horstman, former CEO of DVDPlay, which partnered with McDonald's to create Redbox, a multibillion-dollar retail automation company

