GODDARD
PRODUCT DEVELOPMENT

CASE STUDY

Goddard ACE: How Advanced Collaborative Engineering Built Out Client Sensor Labs

Overview

Service

Goddard ACE (Advanced Collaborative Engineering)

Project

Sensor Labs

Discipline

Industrial Automation, Robotics

Teams

Mechanical Engineering, Electrical Engineering

Systems Expertise

Motive for OptiTrack (Motion Capture), Nanotec Software, Cisco Switch Configuration, Banner Engineering PLC Software, HMI Software, 3D Printing, SOLIDWORKS®

Introduction

Goddard Product Development, a bi-coastal product development consultancy, was hired by a large, global company building automated systems for their warehouses. Parts of these automated systems require sensors, but the client was unable to find an existing company that performed sensor validation to the degree that they required. To solve this problem, the client decided to create a large-scale sensor lab under their hardware test group. Crucially, this automated lab needed to safely interact with humans. The client required additional staff during the lab's early development and selected Goddard's Advanced Collaborative Engineering program to support their internal team with exceptional electrical engineering knowledge, citing the company's extensive industrial automation experience. The sensor lab allows the client to easily test their sensors in a single location, reducing risks associated with ad hoc testing.

The Project

The project objective was to build out the sensor lab's networking and safety systems to IEC 61508 SIL 3 from the ground up and design modular fixtures for the variable requirements of the lab to support sensor validation. The sensor lab's primary purpose is sensor validation—testing the capabilities of existing or new sensors, specifically camera and LiDAR in this case. The goal was to give the client test results that confirm if a sensor can or cannot be used for its intended application and provide qualitative comparison results between sensors. Importantly, these fully automated labs needed to safely recognize and interact with humans. Goddard was asked to take these high-level requirements and produce a robust, repeatable system. With Goddard ACE, electrical and mechanical engineers from Goddard embedded directly on-site with the client to bring the project to completion.

Goddard ACE: Advanced Collaborative Engineering

Embed Goddard's expertise to reduce risk and accelerate productivity. Goddard has a robust staff of multi-disciplinary, dedicated engineers, designers, and project managers to embed on client's projects. Staff can embed remotely or on-site for local clients in the greater San Diego, Boston, and Seattle areas.

Project Highlights

Multipurpose Design

In the design process, the engineers found that space in the lab was at a premium, and test fixtures couldn't be bolted to the floor and permanently installed. They needed to be mobile, interchangeable, and adaptable for multiple tests. To address this, Goddard's mechanical engineers prioritized robust, multipurpose features. They made the designs mobile and reconfigurable, making them easy to move or put into storage. The electrical engineers focused on making the systems as modular as possible so that when troubleshooting was needed, each part could be focused on individually without affecting nearby parts.

Speed & Efficiency

As with many product development projects, requirements changed over the course of the project. To avoid losing time to these changes, the teams focused on a minimum viable product, such as a test fixture that could be used once and discarded. They determined that if the first version gets the job done, there's no need for multiple design revisions and incremental improvements that cost time and money. The sooner test results could be turned around from the sensor lab, the better. After confirming requirements with the customer, the Goddard team leveraged quick turnaround machine shops and 3D printing for test fixtures, sensor mounting, cable management, mounting plates, and lab infrastructure.

The Product Development Process

Electrical Engineering

The electrical engineering team came into the project with expertise in network engineering and design for safety standards. Safety is paramount for humans working alongside automated systems. The electrical engineers' primary goal was to develop a smart safety system integrating custom safety protocols, networking, and data streaming. The team was given vague design requirements and asked to rapidly turn around and build out the sensor labs.

They designed and built out a complete safety system that meets the required standards. This included building an electrical enclosure for a human-machine interface ("HMI") and creating processes for using the safety system. It also included the design and documentation of Standard Operating Procedures ("SOP") and PLC coding for both labs. Network engineering included the configuration of VLANs and switches, LAN design and implementation, and cable routing mapping and design. Safety engineering (determining the device specifications and design of safety systems) included e-stops, gate sensors, safety PLCs, light indication, and HMI coding.

The electrical engineering team applied these areas of expertise throughout the entire sensor lab. The sensor lab needed to be fully powered electrically, with multiple motors moving test fixtures. The engineers took on the task of overseeing power at both labs, working on the details, including wiring and hardware. They also managed high-level objectives, ensuring seamless device interaction and communication with a central hub. For example, there were 30-40 cameras with proprietary software that only ran on Windows. The team needed to network-engineer communication between the Windows and Linux systems with minimal delay, allowing the data to arrive at the same place simultaneously.

The team designed and set up the network architecture for that communication, including hardware, the IT rack, and configuring the switch itself, essentially designing and implementing the network engineering for the labs. For lighting the lab itself, the team designed, built, and mounted a controlled lighting system that allowed the client to simulate different lighting scenarios that could be encountered in the real world at both lab locations.

The team worked with HMI software for UI/UX design, safety SOP steps, and monitoring. They used Banner Engineering PLC software to code the safety system inputs, and control power distribution to various test fixtures, ensuring proper implementation of safety measures. Additionally, Nanotec Software was used to code the motors and dashboard for testing, enabling precise motor control and performance monitoring. They built and designed interfaces in SOLIDWORKS® Electrical and used Cisco switch configuration software for the command line interface ("CLI"). For motion capture, as the mechanical engineers did, the team used Motive for OptiTrack.

Mechanical Engineering

The mechanical engineering team was provided with minimal requirements and a tight timeline. They had a rapid turnaround time to design, prototype, and test. They focused on creating a minimum viable product as quickly and effectively as possible, backed by the combined decades of product development experience of the Goddard team. The design required tight tolerances for machined parts and components, ensuring modular functionality across both labs. They also needed to maintain a keen awareness of testing requirements and standards, which is imperative for applying test plans to these fixtures.

The mechanical engineers used software tools, including SOLIDWORKS®, Motive for OptiTrack, and 3D printing for prototype test fixtures and high-volume reusable components.

Let’s Build Something Great. Talk to Our Team.

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