The Time I Shot The Lights Out

“Shooting the lights out” essentially means performing exceptionally well, so well in fact that there is literally no competition. Searching the internet provided no real clue as to the phrase’s actual origin, so I thought I’d offer my own: visualize a gunslinger in the old wild west extinguishing a candle’s flame by shooting a bullet at it. A pretty neat trick.

Before I transitioned into Engineering Management, I developed real-time computer systems for data acquisition and process control. Real-time means that the computer must respond properly to stimulus signals within a maximum prescribed amount of time, or the system will not satisfy its intended function. Compared to even the computers in today’s ‘smart’ cell phones, computers were the equivalent of toys. Even top of the line mini-computers could only offer 65,000 bytes of core memory storage. Core memory was slow, because reading data was a destructive process, and the data had to be rewritten. Typical machine instructions could be executed at maximum rates of 300,000 to 350,000 per second. Memory was expensive; often a mini-computer might only have available 8,000 or 16,000 bytes to satisfy an application. Contrast this with today’s PCs which can execute instructions at the rate of tens of millions per second and have 8, 16 or more gigabytes - a billion bytes – of memory, and the ‘toy’ characterization might not seem an unreasonable one.

People like me were the equivalent of gunslingers – doing seemingly impossible things with incredibly limited resources. Over the years I had created many real time systems, but two will always be especially satisfying personally. The first, developed in 1977 for NASA Langley Research Center, supported a pilot wind tunnel program that used Nitrogen gas at cryogenic temperatures rather than ordinary air. The tunnel’s success led to NASA creating the much larger, more capable cryogenic wind tunnel known as the National Transonic Facility. The other system - circa 1979-80 - was industrial, supporting the manufacture of glass bottles.

From a production perspective, in bottle manufacturing a stream of molten glass in distributed to an individual forming section. A chunk of glass is sheared off and falls to an open mold. The mold closes, and compressed air is blown into it, expanding the glass to form the bottle. Depending on the mold, multiple bottles can be produced simultaneously. After forming, the bottle(s) is/are swept upright onto a conveyor line, which transports them through an annealing furnace that reduces internal stresses.

Producing different sized bottles not only required changing the molds, but also establishing different sweep-out motion profiles with precise positioning, velocity and acceleration characteristics for each unique bottle type. Historically, the sweep out

action, like all other operations in the production process, were facilitated purely mechanically. Complicating the sweep-out was the fact that there were 7, 9, or 11 other individual sections concurrently producing bottles. Delivering those bottles to a moving conveyor, and inserting them between other bottles involved precision motion control. Delivering bottles too early or too late within a small timing window could have resulted in bottles being knocked over. Purely mechanical change-overs incurred line down-time, which meant lost production. The concept of an “electronic sweep out” with programmable motion profiles offered promise of a significant reduction in down-time.

Given an R&D budget of $25,000, two technicians, and three calendar months, I was tasked with creating an electronic sweep out system. This limited budget meant that the first attempt at solving individual technical challenges had to be successful.

The project began with a trip to the customer’s plant where I saw a number of challenges that weren’t directly related to moving bottles onto the conveyor. In particular, the plant was hot, there was a trace of oil in the air, and the equipment operators wore heavy gloves. The first issue would be solved using an air conditioner for the electronic equipment that operated using compressed air. The other two issues were solved using a custom membrane switch that had ‘push buttons’ that were wider than a typical gloved thumb as well as light emitting diodes that blinked whenever the operator depressed a switch, providing visual confirmation in lieu of tactile feedback.

The circuitry on two existing PC cards that supported a single axis of motion control was re-deployed onto a single PC card, and a new backplane assembly called ‘the motion bus’ was created to transfer motion information to the circuit cards that positioned the sweep-out arm.

Motion profiles for up to 10 bottles were stored in programmable read-only memory chips inside the main processor, a stripped down PDP-11 minicomputer called the LSI-11, programmed in assembly language.

Although I saw the system operating in test mode on our factory floor, by that time I had accepted a management position in a different division, and did not participate in the installation and sell-off of the system in the customer’s plant.

Ultimately, the success of the electronic sweep out led to multi- million dollars in new business as the customer upgraded hundreds of individual sections throughout his facilities. Within my former product line, the circuit cards, system backplane, operator panel, system packaging, and control software were successfully re-applied by other engineers to other projects. Overall, not a bad return on a meager $25,000 investment.

I say I shot the lights out. What say you?

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