

DATA ACCUMULATION WITH MICROPROCESSOR CONTROL

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ABSTRACT

Use of microprocessor operational control allows accumulation of historical data, the possibility of remote retrieval and automatic notification of elevator failure or malfunction at a monitoring point. This paper discusses the logic for accumulation and some uses. This background and a comparison of information accumulated by major control manufacturers prepares participants for a meaningful workshop on standards for remote monitoring.

1. INTRODUCTION

The use of microprocessor logic for control of elevator operation has produced an unexpected opportunity. While the primary goal might have been to enhance performance, ultimately reduce costs, or simply to make use of available technology as a research and development project, the results encompass all the above plus the ability to very inexpensively accumulate data for later retrieval. This capability is the focus of an open forum later in our proceedings and the topic for my presentation today. My purpose is to present background information which may facilitate our later discussion.

I have had several elevator engineers mention that in development of their company's first microprocessor system, the development engineers found that they had unused memory capability after completing the command sequence for control variables. As memory chip capacity increased and cost went down, the availability of inexpensive memory became even greater, and the increasing sophistication of high-level languages facilitated the task of accumulated information

retrieval. Discussion on possible use of this capacity resulted in the idea that operation might be monitored in some fashion. There may have been reasoned development of this facet of microprocessor control, but I would like to think it occurred as so many major developments, as a logical reaction to opportunity.

What would the engineers, faced with this opportunity have used as the basis for deciding what to monitor? What would your basis be? That should be the beginning of our forum discussion. As I considered these questions, I began to think in terms of the riding passenger, the building manager, and the elevator supplier, as well as the elevator engineer. The question to be answered is, "What objective would each of these entities have in developing monitoring capability?"

2. THE PASSENGER

The ultimate objective in any elevator development is to better serve the passenger. In my experience, the highest praise given to any elevator system is to be taken for granted...no comment at all because there is no cause to take notice of the elevator trip, no cause for concern, no cause to question why something happened or what was that noise, no cause for frustration because of delay. The question raised then becomes, how can the passenger's objective - no concern - be enhanced by monitoring elevator performance and operation?

3. THE BUILDING OWNER/MANAGER

The building owner and his manager want building tenants and visitors to react positively to elevator service. Developers spend a sometimes inordinate amount of money creating an "interior experience" in the elevator cab. More and more they are concerned with the "quality of ride", "waiting time for service", the uniqueness of fixtures, and other elevator details. But always in this concern to differentiate the product they will present to the public, they demand the lowest possible price. They seek fillet ambience at hamburger prices and, of course, they expect elevators to operate without fault or shutdown, even for scheduled maintenance. The question then becomes, how can the owner/manager's objective - positive passenger reaction at lowest cost - be enhanced by accumulation of information relative to elevator operation and performance?

4. THE ELEVATOR SUPPLIER

The elevator supplier normally reacts to the market. If elevators are sold on the basis of price, the prudent supplier seeks to provide an acceptable product at the lowest possible price. If purchase of equipment is motivated by quality of ride or optimized response to registered hall calls, or any other of a myriad of possibilities, the prudent elevator manufacturer seeks a response in his product to that sale motivator. The more-sophisticated purchaser is now concerned with cost of maintenance - before equipment purchase - and this must now be considered an objective in equipment design. The question restated again becomes, how can the elevator supplier's objective - market acceptability at competitive price - be enhanced by information accumulation?

5. THE ELEVATOR ENGINEER

Finally, there is the elevator engineer. Everyone has submitted their list of preferences and objectives, and the engineer is presented with the task of developing the capability to meet these preferences and objectives within budget constraints and within the capability of the existing system. The interesting thing here, is that the elevator engineer may have an additional set of priorities in data accumulation and monitoring. He may have academic interests that have a pure research motivation...how many times in given periods do we have door reversal with different settings of door hold times? How many times are stops made without passenger transfer? How many stops are made by each elevator? The list is limited only by the imagination. How can the inquisitive nature of the elevator engineer be satisfied within the final accumulation package?

Whatever the genesis that brought about accumulation and subsequent retrieval of elevator operation information associated with microprocessor control, development of very significant tools has occurred in several areas.

6. SITE MONITORING

Most building engineers and managers I talk with are intrigued with the possibility that they can have a CRT in their office that will allow them to observe elevators in real time operation. Original operatorless elevator systems included elaborate lobby panels which allowed a lobby attendant to verify elevator position and travel, to observe registered hall calls by floor and travel direction, and to change the otherwise automatic operating mode. As we became

more confident in the capability of automatic systems, lobby attendants monitoring elevator operation became increasingly rare. The lobby panel was reduced in size and relocated so that it was no longer in public view. The primary functions became security and emergency, rather than operation monitoring. In many smaller buildings, the panel was omitted altogether. I think many managers and engineers miss the opportunity to "manage" the elevator operation that was available with the lobby panel. They welcome a new tool which can provide much more than simple observation of position and motion of cars in response to registered hall calls.

For the maintenance technician, site monitoring with a visual display unit allows verification that elevators are operating normally, especially after corrective work has been accomplished. There is nothing like a face-to-face meeting...even with a monitoring screen.

7. DIAGNOSTICS

Every field person longs for the opportunity akin to rescuing the fair damsel or handsome prince in distress, that occurs when an elevator has stopped running for unknown causes. This is the stuff that daydreams are made of. Rushing to the side of the ailing elevator, taking the vital signs and restoring the patient to full operating health. Those who perform these functions well are relegated to star status; some even become folk heroes of sort. When I first worked as an adjustor's helper, I was awed by the operations manager back in the office when my mechanic called for assistance. On the telephone, with only a few sentences of problem explanation, he would suggest avenues of investigation that invariably led to solutions. In a way that is the same function the microprocessor can perform today. By monitoring elevator operation, even intermittent faults can be noted and held in memory for future guidance of the serviceperson.

8. REMOTE MONITORING

That operations manager back in the office that I mentioned solved a myriad of problems for men working in the field. His unique experience and abilities were multiplied because he did not have to physically inspect each ailing elevator at the jobsite. His human sensors could report conditions by telephone. Remote monitoring has even greater potential because the reporting sensor is not human and can function

continuously. Failure and potentially serious faults can activate automatic alerts to summon assistance even before the problem would be evident at the site.

9. FORENSIC INVESTIGATION

Logging historical events would have significant importance in, say, accident investigation. In countless situations, human observation has been difficult or impossible to prove or disprove, simply because the evidence was not available. Support or rejection of a perceived experience, was accomplished by "experts" who created logical explanations for a possible occurrence based on conditions they observed following the event. The ability to retrieve conditions preceding failure may provide hard evidence as to the precise event precipitating the perceived experience - possibly positive proof to support or disprove a claim.

10. PERFORMANCE EVALUATION

What is the proper response to the tenant complaint, "I waited almost 10 minutes for an elevator this morning."? Until now the answer has necessarily been defensive..."Well, that hardly seems possible since data we reviewed just last month indicated that the average duration of registered hall calls over the work day was under 30 seconds." That kind of response doesn't satisfy the tenant, nor does it answer the question whether, in fact, a long wait did occur. Accumulation of hall call registration duration in time blocks by floor and direction is well within the capability and capacity of today's microprocessor systems. This capability becomes another of the "management" tools that so intrigue the building manager and engineer. "Let's take a look at the computer record. What time did you say you waited so long? Ah yes, here is a down call at the 3rd floor this morning about that time that was registered for almost 3 minutes. That must have been the one you experienced. You're right, we should have no calls registered that long without being answered. I will report the problem to the service technician and we will find out what the problem was." Imagine then, that the technician's investigation, using accumulated data, indicates that a car was stuck at the 3rd floor with an open door lock contact for about 5 minutes around 10:00 a.m.

Performance evaluation is not limited to response to hall calls. It could be extended to car calls. It can be used to monitor individual car functions such as door cycle times, floor-to-floor performance time, car speed, load weighing activation, etc.

11. MAINTENANCE ASSISTANCE

Retrieval of system events, especially those related to faulty operation could provide immediate direction for needed maintenance and adjustment. Accomplishing these tasks on a priority basis could minimize the possibility of an unscheduled shutdown due to failure, and be a very-positive addition to the routine preventive work accomplished on a scheduled basis.

Maintenance assistance can range from shortening and simplifying a difficult task to reporting the cause for operating a very explicit degree. An example of task simplification: "Tenants constantly complain that indicators fail to function properly. Checking each button and fixture light for proper operation is an almost impossible task, often left to chance reporting or observation. Again, the microprocessor control has capability to continuously monitor each indicator and provide an immediate report to the serviceperson if failure has occurred." An example of specific failure reporting: "Elevator motion failure due to open motor field coil."

12. DATA BASE

Accumulation of information of any type provides an historical base that can be used for many purposes; some yet undefined. For example, the frequency of interlock failure could indicate that redesign would reduce unscheduled failure by a significant percentage. In turn, this could be equated to very specific cost savings.

13. CONCLUSION

From my view, there is no doubt that the stepchild, data accumulation, is a prodigy. Intelligent selection of information and events for alert and later retrieval can provide significant response to the objectives of elevator passengers, of building owners and managers, of equipment suppliers, of consultants and...even elevator engineers. The only limit is our imagination and the company budget!

Hopefully, these remarks will be starting point for your thought. I hope they whet your appetite and stimulate your desire to participate in the workshop discussion. The handouts given to each of you include a listing of the information accumulated in the microprocessor operating systems provided by representative manufacturers, along with a short discussion.