PC-ELEVATORS SYMBIOSIS

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ABSTRACT

Personal Computers (PC) and elevators have undergone a major evolutionary process during the last decade. PC's have evolved from specialists' equipment to the everyday common users. Elevators now utilize several types of microprocessors for different purposes. The application of PC to elevators enables improved local and remote management. This paper describes how a remote or in-situ PC may carry out monitoring, data logging and programming functions to improve the performance of the elevator system. Monitoring enables full recording of faults and events. Data logging allows subsequent statistical analysis. Programming allows changes to be made to the controller parameters. Real time animation and other multi-media aspects are described.

1.0 INTRODUCTION

For over a decade, modern lift control is based on electronically designed control boards. These controllers function through a eight or sixteen bit computer chips. Since these computer chips are much alike those used in a micro-computer, it was natural to let these two communicate and enhance the lift group performance. Two types of communication should be considered by the relevant application. In-site peer-to-peer communication and long distance via telephone line or wireless communication. In general, the communication between a PC and a group of lifts should be bilateral which means that both sides may initiate and cause changes at the other side of the line.

Channelling information from the lift group to the PC may be used to the following purposes:

1. Real time monitoring of lifts groups traffic.
2. Faults and special events recording for real time alert and later-on scanning.
3. Performance data logger for statistical analysis of lifts group.
4. Faults messages sent by the controller through the PC via FAX to a maintenance service office.

The other aspect of the bilateral communication is channelling information from the PC to the controller:

1. The PC takes over certain parameters in the electronical controller such as timers and special statuses that may be altered and directly affect the performance of the lift group.
2. The PC sends calming voice messages through a sound card to a broken cabin to assist the passengers.

The modern PC allows enhanced communication and multimedia features such as high resolution graphics, audio and video capabilities. These features should be utilized in aid of animated monitoring and voice driven messages operated via relevant and convenient type of communication. Following the above described rules, one might centralize a wide range of control abilities thus save time and money which means better service and better performance of the elevators.

A well functioning monitor must be capable of communicating with any controller brand. This might be done through a special interface which will translate all the collected input and output signals from the controller and transfer them to the PC.

2.0 HARDWARE AND COMMUNICATION

The choice of optimal platform for the system must consider two major aspects. First it must account for the basic needs which means that the machine has to be strong enough to carry out a real time performance including number crunching calculations and high resolution animation and graphics. This also includes fast reactions to communication alerts. Second, the entire system must be financially attractive to the potential customer. Up to date optimal choice seems to be a 386sx based PC with high resolution SVGA monitor and minimal 1 MB RAM and 40 MB hard disk. RS232 communication port and printer parallel port are required as well.

A common communication type between controllers and between a PC and the controllers is the 422 communication. This has to be converted into a RS232 type through a board installed in the PC. The communication flows through well protected wires as the entire system functions in a very noisy area with 380 Volts engines and high spikes.

3.0 THE MONITOR

Real time monitoring consists of the most important data needed by the user. A human factor study shows that too much data shown causes the user to neglect the system and leads gradually to total abandonment. The most important features to be detected, recorded and shown are:

1. Car location.
2. Doors position.
3. Direction arrows.
4. Hall and car calls.
5. Faults and special events.

All these features should be set up properly on the screen, not to be too crowded and presented in proper colors so it will not tire the watcher's eyes. Minimum text should be used and graphic figures should express most of the features. See fig. 1 for an example.

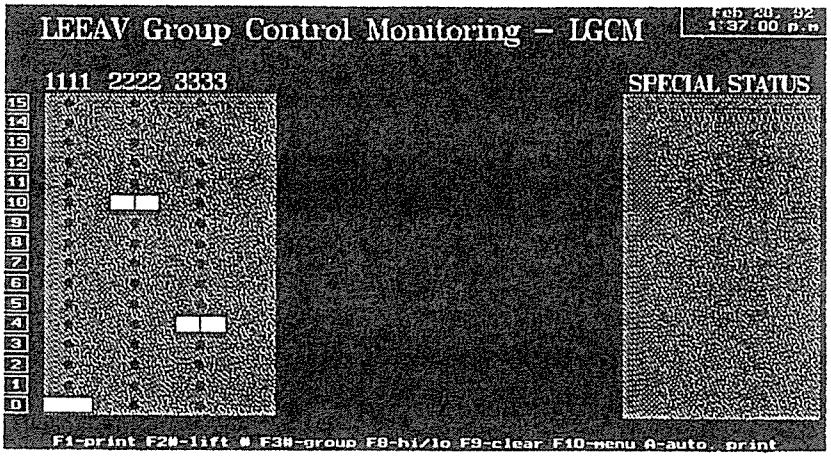

Fig. 1: Group Control Monitoring - real time animation screen

Obviously the monitor should cover any type of elevator system configuration. This means scrolling up and down through all floors in case there are too many to be shown in one screen, and side scrolling in case of too many lifts to be shown in one screen. Certain lifts within a building may skip certain floors still occupied by others. This has to be refereed to and shown graphically.

A special attention should be drawn to the faults and some special events occur during the operation of the elevator system. First they must be shown in real time as written messages on the screen and might be announced by a voice driven sound card. Second, faults and events must be recorded and saved on a hard disk for future scanning. Also, certain faults may be considered for immediate treatment and this may be carried out by messages sent by the PC to a maintenance office by FAX or other telephone service. This announcement should include all the information needed by a technician to harry up with repairment services.

For a trained technician, another type of monitor serves to present all the input and output bits passing through the controller. This may be presented (see fig. 2) in a tabular form showing all the ports are 8 bits bytes toggling on/off positions.

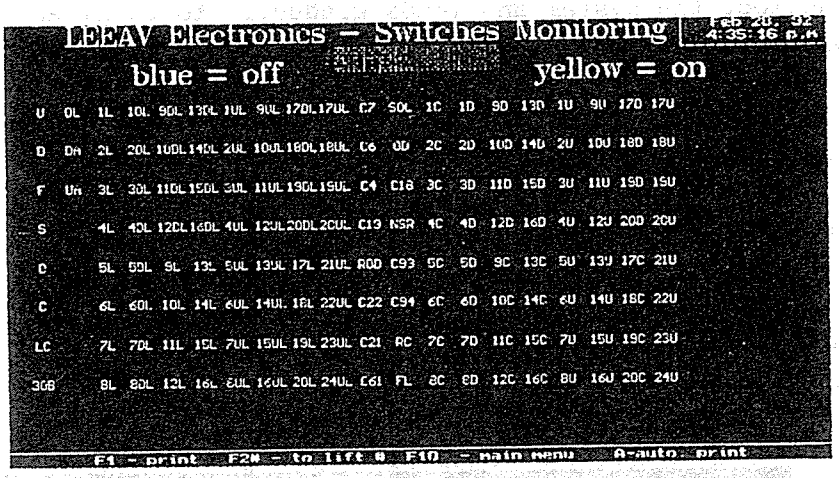

Fig. 2: Input/Output bits and bytes real time monitoring

4.0 THE DATA LOGGER

When a group of elevators is concerned, it is very important to optimize its operation in terms of shortening waiting times as much as possible. This means definition of certain zones throughout the height of the building in which the members of a group of elevators would be distributed in a rest position and will react in the shortest possible time to the next hall call. The best way to carry out this optimization is to collect data on the group performance during certain time. Then perform a statistical analysis in terms of waiting times sectioned certain parameters such as between dates, between hours and between floors. The data to be logged should include:

1. Date and time.
2. Floor from which the call has been made.
3. Waiting time which means the time that has passed from the call until the elevator has stopped and open doors in the relevant floor.

The above described logged data allows to show all calls as done chronologically, averages of waiting times and percentage of how many calls has been responded at certain time intervals - 0 to 10 seconds, 10 to 20 seconds etc. (see fig 3 and 4).

By choice made in advance, the PC may decide upon data logged and analyzed to change waiting zones distributions along the building. Thus optimizing the performance and make the fully adaptation required to improve the elevators traffic.

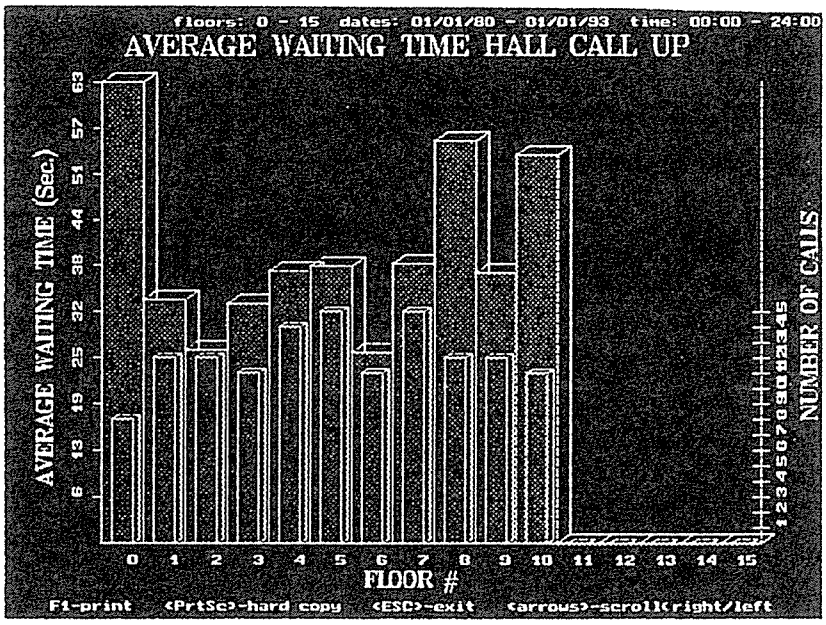

Fig. 3: Average Waiting Time of data logged for elevator system

5.0 THE PROGRAMMER

Certain timers and statuses may be changed during the elevators operation to improve performance. Timers as door open, service period, obstruction, floor delay etc. Statuses such as firemen floor, activate/disactivate a lift, generator type, door position at lobby, staggered floors etc. All these may be defined apriory and let be programmed from the PC onto the controller. Also the PC may cause lifts travel by sending calls signals (hall and car). The ability to change timers and statuses in the controller serves mostly a service personnel to improve relevant features. This option is very sensitive security-wise and should be well protected by password. Also, any programming feature should be well examined before the actual command is sent to the controller. This may be done by several communications over each command, confirming that what has been sent actually obtained by the controller.

6.0 CONCLUSIONS

Personal Computers should play important role in the operation of the modern elevator system. The special graphics and sound capabilities are used in the aid of the total control task. Its computation power enhances the possibilities of real time service and real time performance optimization. It provides monitoring capabilities simple enough to be detected by a non expert user such as a door man or a

maintenance worker. As progress is made very rapidly in this area of personal computers, it is expected that more features would be possible in this nice symbiosis of PC-Elevators.

BIOGRAPHICAL DETAILS

Dr. Doron Shalev has B.Sc. in Civil Engineering from the Technion - Israel Institute of Technology, Haifa. M.Sc. in Structural Engineering from the Technion. Ph.D. in Applied Mechanics from Virginia Polytechnic Institute, Virginia, USA. Currently employed at Tel-Aviv University and Leeav Electronics which develops and manufacture electronical lift controllers and monitoring systems.

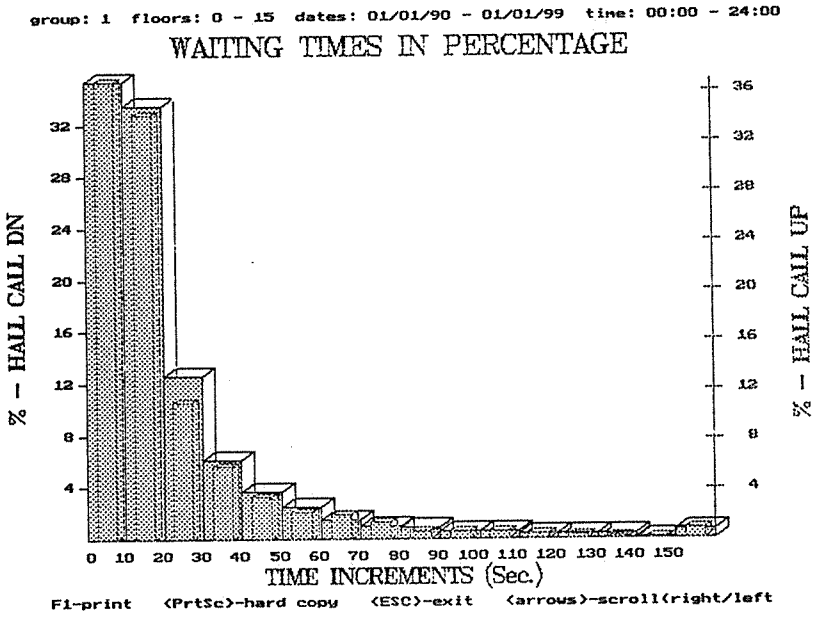

Fig. 4: Percentage of Waiting Time Increments for Hall Calls - Dn & Up