Institute of Acoustics

THE DESIGN, IMPLEMENTATION AND COMMISSIONING OF A COMPUTER-CONTROLLED, MULTI-ZONE SOUND SYSTEM FOR THE ROYAL HONG KONG JOCKEY CLUB

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INTRODUCTION

The Happy Valley Public Address System started on the drawing board in July/ August 1986. It followed a 10-day survey of the site and attendance at several race meetings prior to the close of the 1985-86 season.

The surveys involved acoustic measurements together with a basic familiarisation of the format and proceedings that encompass a race meeting.

Reverberation time measurements were taken in most of the spaces to assist with the selection of loudspeakers and to provide data to predict, in terms of intelligibility, the performance of the system. Recordings were also made of the crowd noise during race meetings to assess the output requirement of the system.

A design study was presented to the Club in November 1986 and by mid-January 1987 a tender specification was issued. The tenders from prospective contractors were evaluated during March and April and finally the contract was signed on 1st May 1987 with a local contractor.

The system now in the final stages of tuning was used for the first time on Saturday 19th September for cross-betting. It has been used subsequently for all race and cross-betting meetings.

THE DESIGN REQUIREMENTS

Any design criteria must be based on a similar maxim to that used by the patent office, i.e. 'A Well Felt and Honest Need'.

In the case of Happy Valley, a system was already in existence hence in the absence of further information there was clearly a need. The old system however fell well short of even the minimum performance criteria both in respect of coverage, quality and flexibility. For this reason therefore, the system was not used to exploit the full range of possibilities.

The prime consideration of this and any public address system is the passage and transfer of information to others. Clearly for this basic criterion to be met, the output of the public address system must reach all concerned and be intelligible. In addition, of course, the system has to meet the requirements of any operational criteria.

Fortunately, the requirements for a public address system at Happy Valley are fairly well defined. The basic requirements are as follows:

Routine Public Address Announcements
Commentary (Chinese and English)
Turf Talk
Emergency Announcements.

In addition to the above, the following considerations were made:

Flexibility to route to and access different zones;
Flexibility to reconfigure the system to cope with the differing requirements of race meetings, cross-betting and other special events;
Integration with the diamond vision and CCTV;
Minimise the noise nuisance to Happy Valley residents;
Crowd control at entrances to site.

As separate from the main public address system, a further system to deal with communication between the Betting Organisers Office (BOO) and betting booths were also required.

In this case the system was basically replacing the existing but with emphasis on improved sound quality with better coverage.

DESIGN PHILOSOPHY

The Happy Valley Public Address System is intended to fulfil a number of functions as follows:

1. To provide public address to spectators (Members and Public).
2. To provide emergency messages.
3. To provide Betting Office Organisers (BOO) information to betting booths.
4. To provide good quality CCTV (turf talk) to Members and Public.
5. To provide input to local crowd control areas.
6. To provide good public address for the forecourt areas for functions other than horse racing.
7. To provide background music if required.

Consideration has been given to ensure that the system is not totally dedicated and that if the requirements change in the future, the system should be adaptable.

Due to the requirements for increased flexibility such that the operational performance of the system should not be compromised, we specified a computer routing and priority system.

In addition, to possible advantages in the future, we believe that such a system will prove useful both in setting-up and in an operational sense.

In view of the noise nuisance problem and with due regard to the topography of the site and its operational requirements, we specified a distributed loud-speaker system.

Considerable attention has been paid to ensure that loudspeakers and associated equipment are both highly reliable and fit for the environmental conditions expected.

The inputs to the system consist of five microphone announcer stations, one land line from another race course located at Sha Tin, two line level feeds from the closed circuit television system, three local music sources as well as line inputs from other parts of the building.

The routing and priority system is capable of operating in four preset modes as follows:

1. Set-up and test.
2. Raceday.

3. Cross-betting.
4. Special function.

The operating mode is determined by a keyboard located in the control room.

Each mode of operation has a separate routing and priority structure, the priority being inherent within the system, the routing patterns being pre-settable by utilising the set-up routines within the main computer software.

The installed hardware has provision for the expansion of the system to incorporate up to 16 inputs with output routing to 40 specific and distinct routing outputs, without additional equipment, this can be expanded later to a total of 64 outputs.

The system outputs have been structured into a number of zones and sub-zones. It is possible to reconfigure the paging zones via the computer control system.

System control may be divided into three modes:
i) Automatic
ii) Operator
iii) Technical.

Automatic Mode: This is primarily concerned with automatic output level control, which sets the system output level to maintain the necessary signal-to-ambient noise ratio. Four noise-sensing microphones are employed to provide information from the varying types of locations within the building complex.

Operator Mode: This mode of operation results from input from a local control panel.

Each control panel is able to page designated areas by push-button selection.

Technical Mode: This mode is intended to allow the technical staff to input the system for test and configure purposes. Access can be from:
i) VDU terminal and printer
ii) Hand-Held wireless remote controller.

The VDU terminal allows the technical staff to make radical changes to the system via the software to ensure maximum flexibility in operation. The software is configured to allow changes to zone definition and grouping. The printer has been included since this will provide a permanent record of the system configuration (as set-up) together with a Log of paging announcements.

Hand-held wireless remote controller - this allows the technical staff to test and check the system. The controller has access on a technical zone basis, this has three distinct advantages:
i) It allows single-handed setting-up of the system prior to race day.
ii) It avoids the necessity of turning on the entire system for test purposes, thereby avoiding complaints from local residents.
iii) It allows 'on the spot' assessment of the system status.

The hand-held controller could also be used during race meetings to make system gain adjustments if necessary.

Prestigious areas, such as boxes and clubs, are provided with individual local volume controls.

In addition to the routing and priority module, the system employs comprehensive and sophisticated signal processing. Extensive use has been made of equalisation. The system employs over 60 - ⅓rd octave graphic equalisers to compensate for the different frequency response of loudspeakers and spaces.

The system comprises 125 power amplifiers giving a total potential output of 70 kW. The amplifiers are fed from ⅓rd octave graphic equalisers. In all, we estimate that some 35 Km of cable was used.

THE SIGNAL CHAIN

Each input to the system be it microphone, music source or line level signal from off-site has associated with it a buffer amplifier to bring the signal to a standard level, a compressor/limiter to provide protection to subsequent stages in the chain as well as providing a measure of protection from variations in level from signal sources. In addition, each input has provision for equalisation to compensate for variations in source material content and optimise speech source intelligibility.

After input signal processing, the signals are routed via the routing and priority matrix under the control of the computer system. Following the routing matrix signals are buffered as required and distributed to the output equalisers, the function of these units being to provide an essentially 'flat' signal output from the system independent of the type of loudspeaker used on any given output. Following equalisation, the signal is applied to the main gain control stage, a digitally-controlled attenuator, whose function is to set the level for an individual amplifier or amplifiers, as well as to implement the noise level sensing.

All the power amplifiers used within the system operate in a bridge mode output which allows the system to provide what is essentially a balanced 100 volt line signal output without the use of transformers.

Comprehensive patching facilities are included within the system in that the inputs to and outputs from every discrete stage in the system are available to the operator to enable him to bypass and substitute circuits in the event of a fault as well as to allow the possibility of temporarily making gross changes to the hardware configuration.

Comprehensive monitoring and self-checking systems are incorporated into the hardware and software that allows the operator to be informed immediately of any fault occurring during operation as well as allowing diagnostic information to be obtained during fault-finding.

Should the main computer control unit fail during operation, the system reverts to a pre-configured back-up mode of operation that allows basic system functions to be performed such as paging and emergency announcements.

LOUDSPEAKERS

The system employs some 3000 loudspeakers comprising approximately 15 types. Each loudspeaker has been selected to acoustically match the space and environment.

Of the 15 types, 5 are most in evidence, these being:

1. Electro Voice Musicaster 11A, used mainly in outside areas.
2. BES C12 and C60B used principally in inside areas with low ceilings.
3. Wall mounted high quality units used principally in smaller rooms with a high standard of decoration.
4. Horn bass unit combinations used in outside areas requiring high quality high sound levels with well defined area coverage.
5. Bose 102 units used solely within the betting booth system as well as in other areas where their small size was advantageous.

CONCLUDING REMARKS

The foregoing demonstrates both the need and the reason for designing and installing a comprehensive public address system. In addition, there is the matter of emergency announcements. Through the design process, we and the Club have been mindful of this eventuality hence the priority structure. We are also aware that in the near future there is impending legislation regarding the performance of the public address systems in the event of an emergency.

We have been at considerable pains to provide a system that would cope in the eventuality of an emergency, the noise sensing system will ensure that the public address system is louder than the ambient. The police have the ultimate control, as suggested by Mr. Justice Popperwell. In addition, the system has considerable headroom to deal with extreme ambient noise.

For the future the computer control and the zoning provides the possibility of interface with an alarm system. Considerable research is underway on controlled evacuation procedures, whereby depending upon the location of a fire, the public can be directed out of the building with due regard to the capacity throughput of stairs, etc. In the event that this eventually becomes either desirable or mandatory, the current public address system would interface and accept this input without hardware modification.

On the lighter (though in some cases nonetheless serious) side, the design and implementation of this system has not been without its problems.

For example, the Musicaster outdoor loudspeakers are only available in 'silage green'. The manufacturer's specification quite clearly states that 'they can be painted'. However, the manufacturer, mindful that they are to be used outdoors and mindful that they should be self-cleaning, has produced the enclosure in non-stick plastic. Consequently, paint also will not adhere to the surface. We are currently conducting trials to test the durability of an ICI paint finish.

During the contract period, one loudspeaker manufacturer has ceased to trade and we are currently investigating problems of loudspeaker failure. Loudspeaker brackets were an ever-attendant problem; only in Hong Kong could a bracket be designed one day and 100 be installed 3 days later!

The Happy Valley Public Address System is one of the largest and most complex ever designed. That there have been problems cannot come as a surprise; that they come from the least expected quarters is, of course, always baffling. The solutions and their implementation is a credit to the Club's technical staff and the attention afforded by the contractors.