Intelligent Public Address System

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\textbf{Abstract}—While sitting in a college auditorium of capacity of 900 seats & listening to a speech through loudspeakers, situation arises when the volume of the main amplifier has to be frequently adjusted to compensate the environmental noise level which changes. The speaker has to ask the remote end listeners from the podium whether he is audible or not. This paper proposes a new idea of making this task automatic by providing a feedback loop (wired or wireless mode) from remote end to main amplifier volume adjustment unit, such that when the environmental sound level increases/decreases, the amplifier adjust its level automatically.

The above system can be made more effective by using an improvised smart microphone with microcontroller. There will be two LED, one red & other green imbedded near the mouth piece. It will have an occupancy sensor as one input and volume as another input to microcontroller. If the volume level is not within set value, the RED LED will glow. When both the parameters distance and volume level remains normal, the GREEN LED will remain glowing. These will guide speaker to maintain proper distance & voice volume.

\textbf{Keywords}—PA system, Auditorium, Microphone, Loud Speakers, Transmitter, Receiver, Amplifier, Microcontroller, Occupancy/ Motion sensors

\section{I. INTRODUCTION}

The present PA system Fig.1 suffers from a drawback which everyone must have felt. For example, sitting in a college auditorium of capacity of 900 seats & listening to a speech through loud speakers, situation arises when the volume of the main amplifier has to be frequently adjusted to compensate the ambience noise level which changes as per the number of occupants, their own murmuring sound, acoustic energy absorbed by each individuals, switching in or off condition of ceiling fans, exhaust fans or air conditioners etc. The speaker has to ask the remote end listeners from the podium whether he is audible or not. This paper proposes a new idea of making this task automatic by providing a time gated feedback loop (wired or wireless mode) from remote end to main amplifier volume adjustment unit such that when the environmental sound level increases/decreases, the main amplifier adjust its level automatically.[1][2][3]

\section{II. PROBLEM}

The fig. 1 depicts the present situation & Fig.2 shows the proposed arrangement with time gated feedback loop.

Though the Fig.2 depicts the idea very well but it has to have some additional technical features to make the whole system economical, using the available technology. These requirements are explained below.

\begin{center}
\includegraphics[width=0.5\textwidth]{fig1.png}
\end{center}

\textbf{Fig. 1 Without feedback present system}

\begin{center}
\includegraphics[width=0.5\textwidth]{fig2.png}
\end{center}

\textbf{Fig. 2 With feedback system}

The devices used in realizing the above setup consists of following components.

\begin{itemize}
\item \textbf{(1) Directional Mic –}
\end{itemize}

It has a high ratio of on-axis response to random directional response. In normal sound reinforcement applications, the cardioid pattern will offer extra immunity to system feedback.
Main Amplifier –

This is main amplifier of high capacity say 100W to 500W with speakers, sound boxes etc.

Main amplifier receiver –

It receives the command from Environmental Sound Level Detector (ESLS) transmitter and performs the mute & on action and also change the volume of main amplifier accordingly.

Omni mic –

The omni pattern is attained by restricting sound entry into the microphone to a single point at the front of the diaphragm. Because of this there is very little distinction based on the direction of the impinging sound, and the microphone will respond equally to sound from all directions.

Environmental Sound Level Detector (ESLD) Amplifier –

After receiving the sound level from omni mic, it amplifies and sends it to drive the ESLD transmitter, which transmits the information to main amplifier receiver section.

Method for detecting environmental sound levels

Omni directional microphone –

For detecting environmental sound level an Omni directional microphone has to be used at the rear end as it catches all the vibration, re-vibration etc. in the auditorium. It should then feed this level to amplifier.

Feedback loop –

For wireless arrangement of feeding this signal level, the RF or IF transmitter embedded in the mic can be used.

For the wired arrangement, proper matching & shielded cabling arrangement at proper voltage has to be looped with amplifier.

B. Special time pulse gate circuit between amplifier & Environmental sound level detector unit (ESLD)

The environmental sound level detector unit should detect the environmental sound and not environmental plus loudspeaker sound.

To do so, it is proposed to have an additional control pulse circuit between amplifier & ESLD. The gating pulse should MUTE the speaker output for a short time, during which ESLD will detect the true sound level & transmit or feed to amplifier, which on receiving it, increase or decrease the amplifier volume level accordingly.

After this fraction of a second mute period, the amplifier should run in normal mode. The whole cycle should have a long duration of repetition, may be once in five to ten minutes or so.

As an example, the table below shows the time gated pulses & action performed at amplifier & ESLD end.

As shown in the table below:-

Sr. no. 1: –

It is seen that at sr. no.1 when the amplifier is switched on, the level was say at volume 3 and amplifier was in normal operating mode i.e. on. At the same time ESLD mic is in off position, and the level detector range is in off position. Thus no pulse is being sent from ESLD to main amplifier.

Sr. no. 2: –

After a time delay says 5 minutes, when the main amplifier volume range was still at 3, a time gated pulse generates and send a mute command to main amplifier. Thus stopping its normal amplifying system and making the main speakers mute. Simultaneously the time gated pulse also sends to ESLD and makes its mic on, and measure the environmental sound level volume, say it is 5. The ESLD than generates a pulse and sends it to main amplifier receiver section, making its volume level from previous 3 to new value of 5.

Sr. no. 3: –

After say one second i.e. at 5.01 time, again a time gated pulse is generated which makes the main amplifier on, and mic of ESLD off. Thus the sound system now starts working normally at level 5.
<table>
<thead>
<tr>
<th>Sr.</th>
<th>GATE OR MONITORING PULSE EVERY FIVE MINUTES TIME MM:SECONDS</th>
<th>MAIN AMPLIFIER</th>
<th>ENVIRONMENTAL SOUND LEVEL DETECTOR (ESLD)</th>
<th>MAIN AMPLIFIER RECEIVER ACTION</th>
<th>REMARK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VOLUME RANGE ADJUSTMENT (0-TO-10) VARIABLE VALUES</td>
<td>MODE NORMAL/MUTE</td>
<td>LEVEL DETECTED RANGE (0-TO-10) &amp; TRANSMITTED TO AMPLIFIER.</td>
<td>VOLUME RANGE ADJUSTMENT (0-TO-10)</td>
<td>RECEIVER ON/OFF</td>
</tr>
<tr>
<td>1</td>
<td>00:00</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>3 OFF</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>THE AMPLIFIER SWITCHED ON</td>
</tr>
<tr>
<td>2</td>
<td>05:00</td>
<td>MUTE</td>
<td>ON</td>
<td>5</td>
<td>From 3-to 5 ON</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SAY AFTER FIVE MINUTES NOISE INCREASED</td>
</tr>
<tr>
<td>3</td>
<td>05:01</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>5 OFF</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MAIN VOLUME INCREASED WITHIN NEXT SECOND</td>
</tr>
<tr>
<td>4</td>
<td>10:00</td>
<td>MUTE</td>
<td>ON</td>
<td>4</td>
<td>From 5-to 4 ON</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>WHEN NOISE DECREASED</td>
</tr>
<tr>
<td>5</td>
<td>10:01</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>4 OFF</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MAIN VOLUME DECREASED WITHIN NEXT SECOND</td>
</tr>
</tbody>
</table>

Sr. no. 4: –

The same process is repeated after next 5 mins i.e. making the main amplifier mute and ESLD is switched on. Let it detect new environmental sound level say which is now reduced to 4, hence the ESLD now sends a time gated pulse of volume level of 4 to main amplifier receiver section.

Sr. no. 5: –

On receiving this new level time gated pulse from ESLD; the main amplifier receiver changes its volume from previous level 5 to 4. And again time gated pulse makes the main amplifier on and ESLD off.

The whole process goes on repeating as shown in the table above.

III. SMART MICROPHONE

The above system can be made more effective by using an improvised smart microphone with microcontroller. There will be two LED, one red & other green imbedded near the mouth piece of mic. An occupancy sensor will sense the distance between speaker’s mouth & mic and amplifier will detects the volume level. These two information will lit the red LED through microcontroller if the distance between speaker’s mouth & mic goes beyond a set distance and voice level is low. If the volume level is not within set value, but the distance is right, again the RED LED will glow. When both the parameters, mic distance and volume level remains normal, or, when the distance is more but volume is still within set value, the GREEN LED will remain glowing. These will guide speaker to maintain proper distance from mic & voice volume.
IV. CONCLUSION

An effective mic & sound arrangement is a must in every public gathering, meetings, election campaign, auditoriums, stadiums, Railways announcement system etc. The intelligent mic & PA system will be a boon for such situations/functions.

This new idea, if realized into a product, will prove a great relief in managing sound volume levels in all Public address system giving full benefits to the audience attending the meetings as well as the speaker to effectively deliver his speech or presentation. It has huge market potential & can generate business.

References

[3] Use of public address system with telephone lines. W H Martin and A B Clark