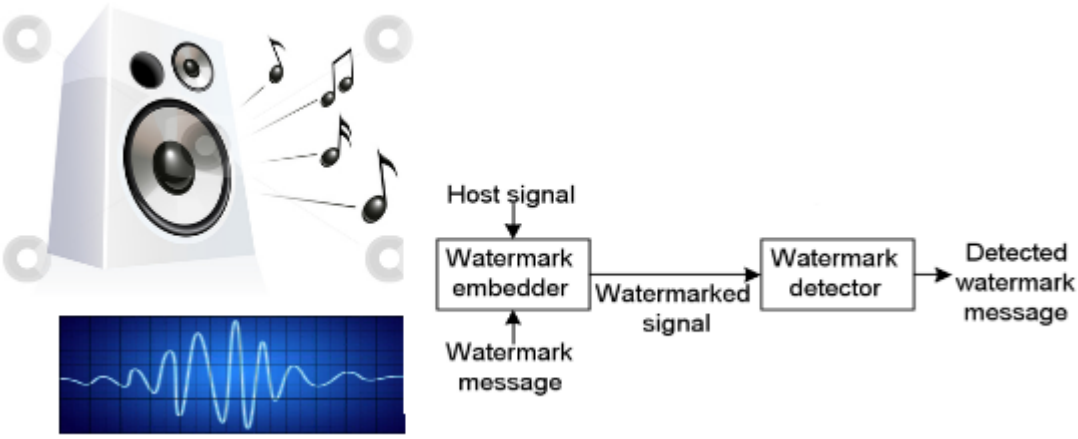
Real-time Audio Watermarking

Audio watermarking is a process that embeds a signal into an audio file which is typically used to control ownership rights. These digital watermarks are added in such a way that the audio signal appears to be unaffected to the listener. Typically the watermarking process will either add a small increase in the amplitude of the signal or exploit frequency bands where very little signal is present.

While this type of procedure is often used for digitally distributed material, it has not yet been thoroughly explored in terms of real-time implementation. Such an example is a music venue or sporting event in which the artists or broadcaster wishes to retain rights while still allowing recording and digital distribution of the created work.

With real-time audio watermarking there are significantly more challenges than the offline approach. The watermark signal as well as the desired signal are broadcast simultaneously, which requires that the watermarking system reacts quickly to changes in the broadcast signal, especially if the broadcast signal's characteristics change. In order to ensure a recording with decent audio properties it may be necessary to incorporate noise reduction techniques at the received microphones which may effect or cancel out the digital watermark, so the watermarking system should be robust. If the recording is done in stereo, there are multiple microphones recording the signal, and therefore the watermark may be distributed throughout different channels.

All of these challenges require that the audio watermarking process be adaptive, meaning that it can react quickly to the changes that occur in the system. The effect on the watermark throughout this adaptive process may make it unintelligible by the watermark detector and useless as a means to control ownership rights for the distributed media. Therefore the watermark detection software must be able to account for the changing characteristics of the embedded adaptive watermark signal.



Your task

Explore current audio watermarking techniques that are applied to digitally distributed files. Apply this knowledge to simulated broadcast audio signals and determine its effect on the watermarking technique. This will then be used in environments that have high background noise scenarios such as concert venues or sporting events. Standard multi-channel noise reduction techniques will be applied to also observe the effect on the digital watermark. Finally real-time simulations will be performed to verify the methodology and techniques developed throughout the thesis research.

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Number of Students: 1-2 **Work Load : Literature 40%, Implementation 30%, Validation 30%**