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(71) Applicant *(for all designated States except US)*: KENT RIDGE DIGITAL LABS [SG/SG]; 21 Heng Mui Keng Terrace, Singapore 119613 (SG).

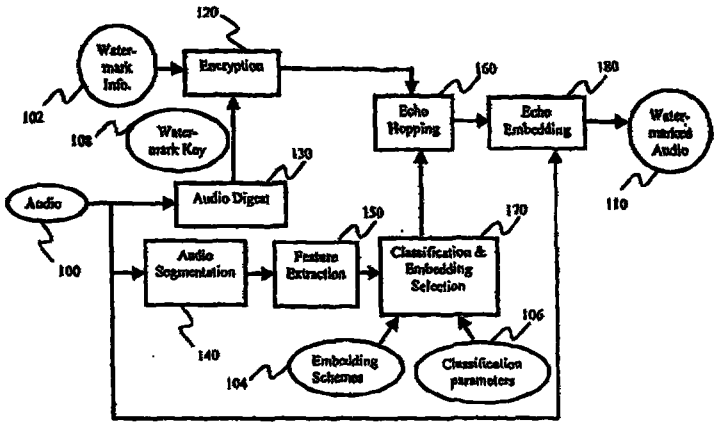
(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: XU, Changsheng [CN/SG]; Blk 702, West Coast Road #13–345, Singapore 120702 (SG). WU, Jiankang [CN/SG]; Blk 51, Teban Gardens Road #06–565, Singapore 600051 (SG). SUN, Qibin [CN/SG]; Blk 407, Clementi Avenue 1 #11–54, Singapore 120407 (SG). XIN, Kai [CN/SG]; Blk 228, Jurong East Street 21 #08–751, Singapore 600228 (SG). LI, Haizhou [CN/SG]; Blk 413, Pandan Gardens #11–132, Singapore 600413 (SG).

(74) Agent: SPRUSON & FERGUSON PTE LTD; 51 Bras Basah Road, #02-03 Plaza by The Park, Singapore 189554 (SG).

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(54) Title: DIGITAL AUDIO WATERMARKING USING CONTENT–ADAPTIVE, MULTIPLE ECHO HOPPING



(57) Abstract

A method, an apparatus and a computer program product for adaptive, content-based watermark embedding of a digital audio signal (100) are disclosed. Corresponding watermark extracting techniques are also disclosed. Watermark information (102) is encrypted (120) using an audio digest signal, i.e. a watermark key (108). To optimally balance inaudibility and robustness when embedding and extracting watermarks (450), the original audio signal (100) is divided into fixed–length frames (1100, 1120, 1130) in the time domain. Echoes (S'[n], S''[n]) are embedded in the original audio signal (100) to represent the watermark (450). The watermark (450) is generated by delaying and scaling the original audio signal (100) and embedding it in the audio signal (100). An embedding scheme (104) is designed for each frame (1100, 1120, 1130) according to its properties in the frequency domain. Finally, a multiple–echo hopping module (160) is used to embed and extract watermarks in the frame (1100, 1120, 1130) of the audio signal (100). An audio watermarking system known as KentMark(Audio) is implemented.