










Attack Type	NC	BER	Extracted watermark
Noise addition	0.9206	10.16	
Re-sampling	0.9335	8.50	
Low-pass filtering	0.9241	9.67	
Re-quantization	0.9285	9.08	
Echo	0.9256	9.47	
Reverse	0.9389	7.81	
mp3 compression (32 kbps)	0.9227	9.86	
mp3 compression (64 kbps)	0.9307	8.79	
mp3 compression (128 kbps)	0.9278	9.18	

TABLE I. NC AND BER OF EXTRACTED WATERMARK IMAGE FOR THE AUDIO SIGNAL ‘CITIZEN, GO BACK TO SLEEP’

Audio Signal	Attack type	NC	BER
Beginning of the End	Noise addition	0.9298	8.98
	Re-sampling	0.9240	9.77
	Low-pass filtering	0.9270	9.38
	Re-quantization	0.9280	9.18
	Echo	0.9288	9.18
	Reverse	0.9175	10.45
	MP3 compression (32 kbps)	0.9324	8.69
	MP3 compression (64 kbps)	0.9145	10.84
	MP3 compression (128 kbps)	0.9248	9.57
Breathing On Another Planet	Noise addition	0.9193	10.25
	Re-sampling	0.9161	10.64
	Low-pass filtering	0.9128	11.04
	Re-quantization	0.9175	10.45
	Echo	0.9152	10.84
	Reverse	0.9070	11.82
	MP3 compression (32 kbps)	0.9230	9.77
	MP3 compression (64 kbps)	0.9085	11.52
	MP3 compression (128 kbps)	0.9089	11.52
Thousand Yard Stare	Noise addition	0.9247	9.57
	Re-sampling	0.9254	9.47
	Low-pass filtering	0.9252	9.47
	Re-quantization	0.9106	11.43
	Echo	0.9219	9.96
	Reverse	0.9131	11.04
	MP3 compression (32 kbps)	0.9249	9.57
	MP3 compression (64 kbps)	0.9229	9.86
	MP3 compression (128 kbps)	0.9167	10.55

TABLE II. NC AND BER OF THE EXTRACTED WATERMARK FOR DIFFERENT AUDIO SIGNALS

Attack	NC[Proposed]	NC[1]	NC[2]	NC[3]
1	0.9206	0.9901	0.5870	0.6619
2	0.9335	0.9950	0.9924	0.7847
3	0.9241	0.9942	0.6272	0.5541
4	0.9285	1.0000	0.9634	0.5454
5	0.9256	0.7559	0.5820	0.7867
6	0.9389	0.4904	0.5737	0.6150
7	0.9227	0.9591	0.5774	0.4034
8	0.9307	0.9650	0.5673	0.4806
9	0.9278	0.9650	0.5524	0.7270

Table III

Comparison of NC among proposed and other algorithm

(Citizen, Go Back to Sleep)

Attack	BER[Proposed]	BER[1]	BER[2]	BER[3]
1	10.16	1.17	47.85	37.50
2	8.50	0.59	0.98	25.00
3	9.67	0.68	43.65	50.00
4	9.08	0.00	4.69	49.00
5	9.47	27.83	49.02	25.00
6	7.81	56.64	48.63	43.75
7	9.86	4.79	49.51	62.50
8	8.79	4.10	49.71	56.25
9	9.18	4.10	52.25	31.25

Table IV

Comparison of BER among proposed and other algorithm

(Citizen, Go Back to Sleep)

- [1] S. M. Tsai, "A robust zero-watermarking scheme for digital audio," *International Journal of Information and Electronics Engineering*, vol. 5, no. 2, pp. 117–121, 2015.
- [2] Y. Yang, M. Lei, H. Liu, Y. Zhou, and Q. Luo, "A novel robust zero-watermarking scheme based on discrete wavelet transform," *Journal of Multimedia*, vol. 7, no. 4, pp. 303–308, 2012.
- [3] H. L. Dai and D. He, "An efficient and robust zero-watermarking scheme for audio based on DWT and DCT," in *Proceedings of the Asia Pacific Conference on Postgraduate Research in Microelectronics and Electronics*, pp. 233–236, 2009.