Noise Interjector for Piracy Avoidance

Jophin. George[1], Sreelakshmi. Menon[2], Sreenivas. S. Pai[3], Vishmol. Babu[4]
UG Scholars
Department of Electronics and Communication
Adi Shankara Institute of Engineering and Technology, Kalady

Mrs. Remya Ramesh
Asst. Professor
Department of Electronics and Communication
Adi Shankara Institute of Engineering and Technology, Kalady

***Abstract*— Film Piracy has been on a rise, the film which is being newly released, is being captured in theatres and is being uploaded into online websites. This causes a great problem for the people who work tirelessly for a film, the results they expect for their hard work is being indirectly stolen. There have been many ideas proposed to address this issue like watermarking techniques, IR based Anti-Piracy screen. One of the ways to tackle this issue is by injecting noises into microphone via its property of non linearity at high frequencies. We propose to solve the issue by initially designing a system that consists of a noise generator.**

***Keywords*— Noises, Microphone, Non Linearity, High Frequencies.**

I. INTRODUCTION

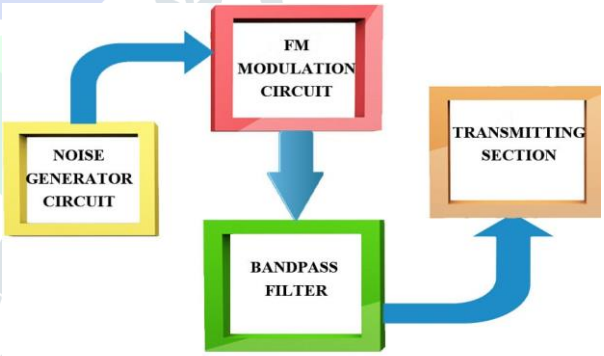
In a technologically superior age we lack suitable technology to detect acts of film piracy. Due to this, films are available on the Internet on the day they are released. The consequence of such acts include unimaginable decline in the expected revenue for the film. Even after the films have left the theatres this issue continues to affect which leads to decrease in the number of legal copies of the film. One of the possible answers to this problem is the usage of Inaudible Acoustics [1]. The Backdoor System [2] is one of the applications of Inaudible Acoustics which explores the possibility to carry data bits. It enables an acoustic inaudible communication channel for today's microphones. NIPA (similar to Backdoor) is proposed to operate the microphone at high inaudible frequencies, thereby invoking the non-linear behavior in the diaphragm and pre-amplifier. NIPA follows an alternate structure of implementation. It uses Chua's circuit, thus Chaos is the noise in the circuit. It is a system that consists of this noise generator which corrupts the audio of the recorded film. It is followed by a FM circuit which enables long distance transmission and a Band pass filter to band limit the signal within a specific frequency range.

In backdoor concept, two tones are generated at say 40 KHz and 50 KHz. These signals are generated using FM circuits and when they arrive at the microphone they get multiplied by the fundamental nonlinearities of the system. This leads to the generation of sum and difference components of frequencies in which the difference component will be within the audible range so that it get mixed with recorded frequencies and corrupt the audio signal considerably. The other frequency components are eliminated by the Low pass filter in microphone.

II. MICROPHONE SYSTEM

In this era of digitization microphones play an important role. By using a microphone we can record audio signals and can be transferred to any place as per our requirement. Microphones are transducers that convert sound energy into electrical energy .Microphones take sound wave or variation in pressure of air as input and gives electrical signal as output. A wide variety of microphones are used nowadays and this paper mainly focuses on condenser microphones used commonly in mobile phones. Condenser means capacitor which consists of two plates separated and insulated from each other and equally charged by opposite charges. Capacitors are used to store energy in electrostatic form. Among the two plates of the capacitor one is very soft and flexible used as diaphragm. Another plate which is strong and fixed is kept at a slight distance from diaphragm. When sound signals strike the diaphragm the flexible part start vibrating Due to this back and forth movement of one plate there is an increase or decrease in distance between the gaps. When the gap decrease the capacitance between two plates increase, electrostatic energy increase, as a result charge current occurs and vice versa occurs when the gap increases. This way a fair electrical signal can be noted from condenser microphones when sound waves strike the diaphragm. NIPA is assumed to invoke the non linear behavior in the diaphragm and pre- amplifier of the microphone.

III. BLOCK DIAGRAM



A. Chua Circuit

The key component of NIPA is noise. The noise generator used in NIPA is Chua Oscillator. Chua's circuit is the simplest electronic circuit exhibiting chaos [3]. It can be readily constructed at low cost using standard electronic components. The circuit has four linear components two capacitors, resistor and inductor. The Chaos exists in the circuit due to presence of the non linear resistor in the circuit. The non linear resistor operates at negative

resistance.

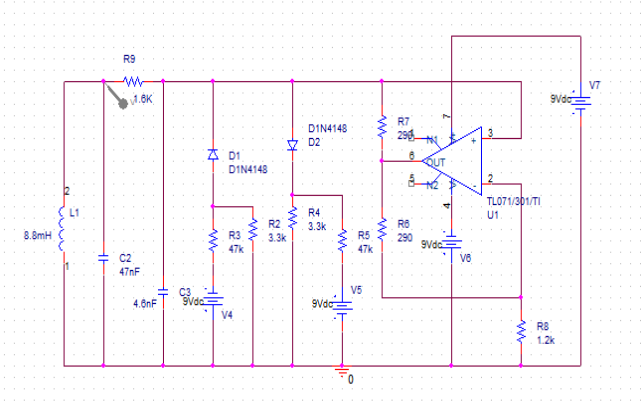


Fig. 1. Chua Circuit Diagram

B. *Frequency Modulation Circuit*

Method of broadcasting electrical signals that cannot travel very long distances by their own. In this method, information is transmitted over a carrier wave whose instantaneous frequency diminishes or increases with the frequency of message signal. The difference between the instantaneous frequency and the central frequency of the carrier wave will be directly proportional to instantaneous value of the amplitudes of message signal [4]. FM transmission operates at a frequency range of 88 to 108 MHz and is less susceptible to electromagnetic interference compared to amplitude modulation.

- In order to maintain the strength of the generated noise signal throughout the device, it is passed through a frequency modulation circuit made of 555 timers.
- 555 timer wired in astable mode can be used for generating frequency modulated waves where the carrier frequency of generated FM is given by,

$$f = 1/ (0.693RC)$$

Here R1=R2=R and C1=C

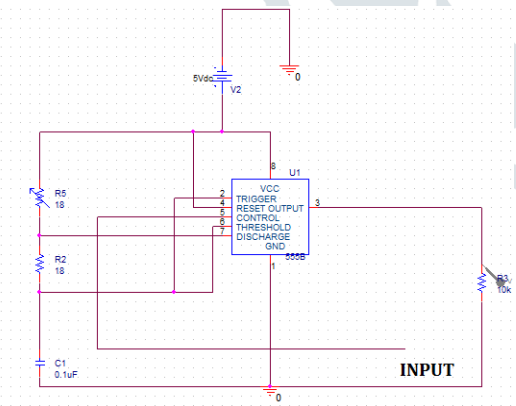


Fig. 2. FM Modulation Circuit

C. *Band Pass Circuit*

The FM Modulated noise has to be band limited to a range of 40-52 KHz. It consists of a high pass filter followed by a low pass filter whose cutoff frequencies are determined by equation

$$f = 1/ (2piRC)$$

Unlike high pass filters which pass only high frequency signals or low pass filter which pass signals of low frequency range, a Band pass filter passes signals within a certain “band” or “spread” of frequencies without distorting input signal or introducing extra noise. The bandwidth of such a signal is given by,

$$BW= f_H-f_L$$

For a Band pass filter to function correctly, the cutoff frequency of low pass filter must be higher than the cutoff frequency of high pass filter.

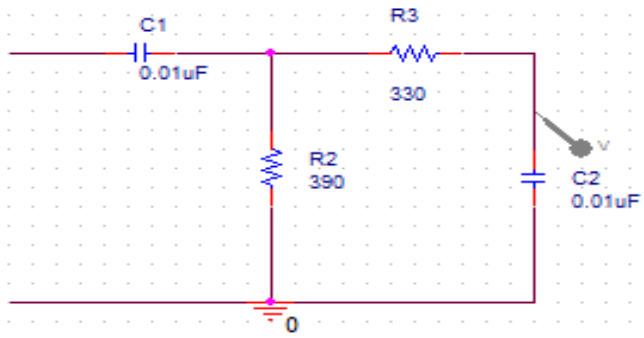


Fig. 3. Band pass Circuit Diagram

D. *Transmission Circuit*

After generating noise and modulating the same with a carrier at a particular frequency, we band pass the signal using an LM 380 op-amp based power amplifier. Output is taken from the speaker and verified whether disturbance is created or not.

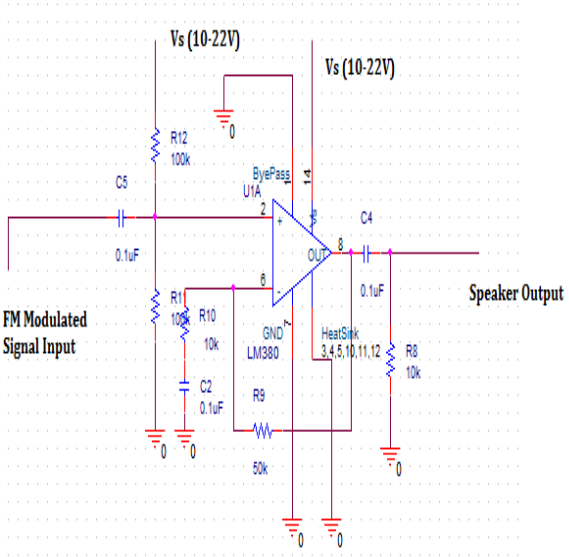


Fig. 4. Transmission Circuit Diagram

IV. RESULTS

The circuits are implemented in order.

Initially Chua circuit was implemented. From the implementation of the circuit the following points were noted.

- Chua circuit is a very sensitive circuit.
- The circuit with op-amp LT1351 was simulated. But due to low availability of op-amp LT1351, It was replaced with op-amp TL071.
- The shape of the output was determined by a specific inductance.
- The circuit was implemented with fixed inductor and a Coiled inductor. The coiled inductor showed

a better shape than fixed inductor. The fixed inductors were arranged in parallel and series to get a specified value.

- Chua circuit output was obtained and the output was found to have frequency lying between 10 KHz - 1 MHz

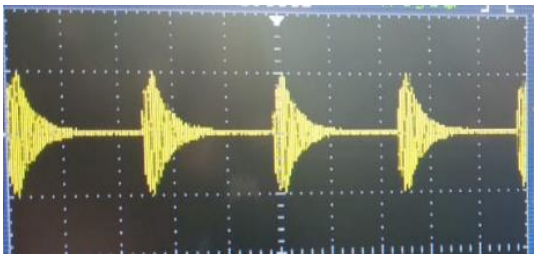


Fig. 5. Chua Circuit Output

The FM circuit was cascaded with noise generator circuit and the output was obtained as frequency modulated noise. The frequency range was found to be varying from 10 KHz - 60 KHz.

Fig. 6. FM Modulated Noise along with Chua Circuit Output

The Band pass circuit was used to limit the range from 40 KHz - 50 KHz. The Band limited output is transmitted via a circuit involving audio noise amplifier with IC LM380 and a sound with 50 KHz frequency is directed towards the microphone. Microphone sensitive to this frequency introduces noises into the sound which is being recorded.

V. FUTURE SCOPE

This paper mainly focuses on the idea of corrupting the recorded audio signal. In future the device can be modified by providing provision for video corruption simultaneously with audio corruption. A position recognition algorithm can be employed to identify the exact location of recording device which may increase the efficiency of the proposed device considerably.

ACKNOWLEDGMENT

This research would not have been possible without the support of Electronics and Communication Department, Adi Shankara Institute of Engineering and Technology. We are deeply grateful to our mentor Mrs. Remya Ramesh for her assistance.

REFERENCES

[1] Nirupam Roy, *"Inaudible Acoustics: Techniques and Applications",* University of Illinois at Urbana-Champaign, 2017.

[2] Nirupam Roy; Haitham Hassanieh; Romit Roy Choudhury; "*Backdoor: Making Microphones Hear Inaudible Sounds*",in Proceedings of the 15th ACM International Conference on Mobile Systems, Applications and Services, 2017.

[3] Leon.O. Chua, Chai Wah Wu, Anshan Huang, Guo-Qun Zhong, "A Universal Circuit for Studying and Generating Chaos- Part I: Routes to Chaos" in IEEE Transactions on Circuits and Systems-I: Fundamental Theory and Applications, Vol. 40, No.10, October 1993.

[4] Jacques Fagot, Philippe Magne, "Frequency Modulation Theory: Application to Microwave Links", Pergamon Press, 1961.