

Sleep Inducer through Generation of Pink Noise

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ABSTRACT: Insomnia is difficulty in falling asleep. People with insomnia can feel dissatisfied with their sleep. Insomnia treatment consists mostly of sleeping pills consumption. The Japanese researchers discovered that sound of rain has a relaxing effect. This project is an alternative for the consumption of sleeping pills. With the help of this circuit, we can generate rain sound which can be a sleep aid in case of insomnia.

KEYWORDS: Insomnia, Sleeping pills.

I. INTRODUCTION

The rain sound generator device is designed to replicate the sound of the rain by using IC 555 timer. The rain sound is assumed to induce relaxation as well as to help boost concentration to humans. This project makes a perfect rain sound effect which will mostly alleviate insomnia problems.

Insomnia treatment mostly consists of sleeping pills consumption but this circuit is an alternative for that and consists of simple circuitry that generates rain sound effect. According to the Japanese researchers, the sound of rain has a relaxing effect. With the help of this simple circuit, we can generate the rain sound which can be a sleep aid in case of insomnia.

The rain sound makes us sleepy because of the monotonous rhythm it generates. The pink noise effect from rain allows our minds to fixate our thoughts to rain sound. Pink noise is a random noise having equal energy per octave. Hence, this noise increases productivity and creativity. The various surveys have shown pink noise regulating the brain waves giving a steady long sleep. German scientists have monitored insomnia patients in the presence of pink noise. This resulted in better sleep for the patients as the researchers played pink noise in the background. The end results are people winding up relaxing easier and thus falling asleep faster.

“Nearly a third of the populations are suffering from insomnia which is affecting their health,” report says. It said that a survey of the nation’s sleep habits found that 30% are severely sleep deprived, putting them more at risk of mental health and relationship issues. Several other newspapers also covered this story, based on a report by the Mental Health Foundation that aims to raise awareness of the importance of sleep for physical and mental wellbeing. Much of what it says in this area is uncontroversial and appears to be sound advice.

Sleep disorders are becoming increasingly prevalent in society. However most of the burgeoning research on automated sleep analysis has been in the realm of sleep stage classification with limited focus on accurately diagnosing these disorders. In this paper, we explore two different models to discriminate between control and insomnia patients using support vector machine (SVM) classifiers. We validated the models using data collected from 124 participants, 70 control and 54 with insomnia.

The first model uses 57 features derived from two channels of EEG data and achieved an accuracy of 81%. The second model uses 15 features from each participant’s hypnogram and achieved an accuracy of 74%. The impetus behind using these two models is to follow the clinician’s diagnostic decision-making process where both the EEG signals and the hypnograms are used. These results demonstrate that there is potential for further experimentation and improvement of the predictive capability of the models to help in diagnosing sleep disorders like insomnia.

Sleep is a fundamental need; the average person spends about one third of their lives in sleep during which the body rests and restores itself. Sleep deprivation, i.e. insomnia, is associated with the risk of obesity, diabetes and cardiovascular diseases. Studies have shown that people who suffer from insomnia have a 350% greater chance of having hypertension than normal sleepers. Sleep disorders are also prevalent in society; up to 40% of the population is affected by a sleep disorder while up to 10% of the population suffers from insomnia alone.

This introduces a computational approach to characterize healthy controls and insomniacs based on graph spectral theory. Based upon expert-generated hypnograms of sleep onset periods, a network of sleep stages transitions is derived to compute four similarity distances amongst subjects' sleeping patterns. A subsequent statistical analysis is performed to differentiate the 16-subject healthy group from a 16-patient disordered cohort. Our findings demonstrated that the similarity distances based on eigen values determination, i.e. d1 and d4 were the most reliable and robust measures to characterize insomniacs, discriminating 93% and 87% of the affected population, respectively.

II. RELATED WORK

The main idea of this project is to give sound sleep for people who find difficulty in sleeping. The rain sounds are music to human ears as they are monotonous in nature. These monotonous sounds can be generated using a simple circuit with basic components like transistors and resistors. There are two variable resistors used in this circuit. POT 1 is used to change the volume whereas the POT 2 is used to change the tone of the sound produced at the output.

Rain sound is an example of pink noise. Pink noise is an acoustical energy distributed uniformly throughout the audio spectrum. Pink noise has uniform spectral density – the same apparent loudness at all frequencies. Hence, pink noise is a remedy for sleeplessness.

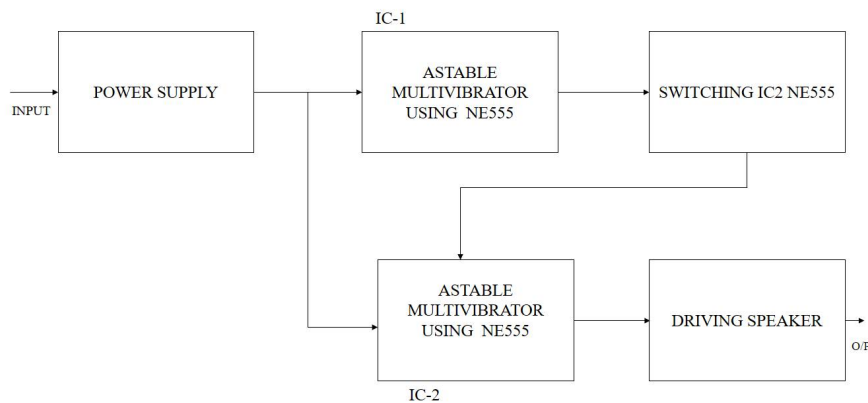


Fig.1 Block Diagram

The input is given using a battery of about 9 volts and this is sent finally to the IC 555 timer where signal of particular frequency is generated and then the generated signal is sent to the transistor for amplification purpose which acts as a driver circuit and then sent as input to the speaker where analog signal is converted to audio signal.

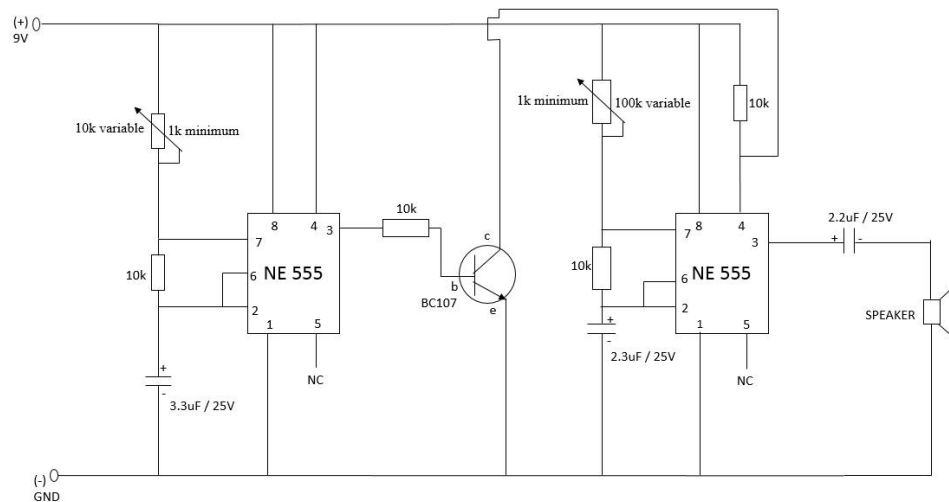


Fig.2 Circuit diagram

The IC555 timer acts as a frequency generator. Further the signal is passed to the next timer for switching purpose and then to the capacitor to filter the noise. The filtered signal is then passed to the speaker and the smooth rain sound is generated.

III. WORKING PRINCIPLE

The internal resistors act as a voltage divider network, providing $(2/3)V_{cc}$ at the non-inverting terminal of the upper comparator and $(1/3)V_{cc}$ at the inverting terminal of the lower comparator. In most applications, the control input is not used, so that the control voltage equals $(2/3)V_{cc}$. Upper comparator has a threshold input (pin 6) and a control input (pin 5). Output of the upper comparator is applied to set (S) input of the flip-flop.

Whenever the threshold voltage exceeds the control voltage, the upper comparator will set the flip-flop and its output is high. A high output from the flip-flop when given to the base of the discharge transistor saturates it and thus discharges the transistor that is connected externally to the discharge pin 7. The complementary signal out of the flip-flop goes to pin 3, the output. The output available at pin 3 is low. These conditions will prevail until lower comparator triggers the flip-flop. Even if the voltage at the threshold input falls below $(2/3)V_{cc}$ that is upper comparator cannot cause the flip-flop to change again. It means that the upper comparator can only force the flip-flop's output high.

To change the output of flip-flop to low, the voltage at the trigger input must fall below $(1/3)V_{cc}$. When this occurs, lower comparator triggers the flip-flop, forcing its output low. The low output from the flip-flop turns the discharge transistor off and forces the power amplifier to output a high. These conditions will continue independent of the voltage on the trigger input. Lower comparator can only cause the flip-flop to output low.

From the above discussion it is concluded that for the having low output from the timer 555, the voltage on the threshold input must exceed the control voltage or $(2/3)V_{cc}$. This also turns the discharge transistor on. To force the output from the timer high, the voltage on the trigger input must drop below $(1/3)V_{cc}$. This turns the discharge transistor off.

A voltage may be applied to the control input to change the levels at which the switching occurs. When not in use, a 0.01 Nano Farad capacitor should be connected between pin 5 and ground to prevent noise coupled onto this pin from causing false triggering.

Connecting the reset (pin 4) to a logic low will place a high on the output of flip-flop. The discharge transistor will go on and the power amplifier will output a low. This condition will continue until reset is taken high. This allows synchronization or resetting of the circuit's operation. When not in use, reset should be tied to $+V_{cc}$.

BC107 is an NPN bi-polar junction transistor. A transistor, stands for transfer of resistance, is commonly used to amplify current. A small current at its base controls a larger current at collector & emitter terminals. BC107 is mainly used for amplification and switching purposes. It has a maximum current gain of 800. Its equivalent transistors are BC548 and BC549. The transistor terminals require a fixed DC voltage to operate in the desired region of its characteristic curves. This is known as the biasing. For amplification applications, the transistor is biased such that it is partly on for all input conditions. The input signal at base is amplified and taken at the emitter. BC547 is used in common emitter configuration for amplifiers. The voltage divider is the commonly used biasing mode.

- Transistor type: npn
- Voltage- collector emitter breakdown 45 volts
- Current –collector (max) 100 mA
- Power max 625Mw

A **speaker** consist of an electromagnet (an electromagnet is simply a metal coil which produces a magnetic field when an electric current flows through it), and a fixed permanent magnet.

When current passes through it a magnetic field is produced in the direction determined by the polarity of the input signal. As the direction or polarity of this input signal keeps on changing, the direction of its magnetic field also changed rapidly. When the polarity of the permanent magnet and the electromagnet are in opposite directions, they feels an attractive force and when the polarity of electromagnet reverses due to the change in input signal, they repels each other. This means that alternatively, they feel attractive and repulsive forces, this keeps the electromagnet to vibrate back and forth.

These fluctuating vibrations are then amplified by first removing ripples or small disturbances in the signal and then produced as output audible signal through a 'cone'. The frequency of the vibrations decides the pitch of the output sound produced, whereas its amplitude governs the volume of the sound produced. Different frequencies of sound are produced by using cones of different sizes. That means we use different sizes of the cone for too high, medium and low output frequencies. A microphone uses the reverse mechanism as that of a speaker, which means it converts sound signals into an electrical signal.

IV. EXPERIMENTAL RESULTS

The Astable Multivibrator is a simple oscillator which generates a continuous stream of rectangular OFF-ON pulses that switch two voltage levels. The frequency of the pulses and their duty cycle are dependent upon the RC network values. The capacitor C charges through the series resistors with a time constant, $(R1 + R2)*C$. The capacitor discharges through R2 with a time constant R2C.

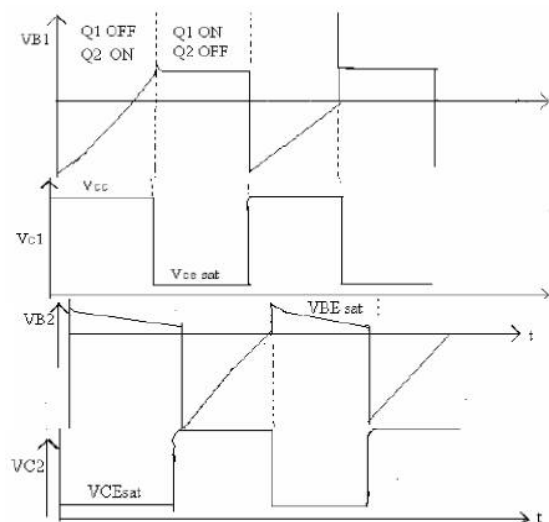


Fig. 3 Graph of Astable Multivibrator

555 ASTABLE MULTIVIBRATOR FREQUENCY, DUTY CYCLE CALCULATION

Inputs: R1, R2, C

Outputs: Frequency, Duty Cycle

Resistance (R1) in K-Ohm (Input-1)	:	1
Resistance (R2) in K-Ohm (Input-2)	:	10
Resistance (R2) in K-Ohm (Input-2)	:	2.3
Frequency of AMV (output-1)	:	0.68571428
Duty Cycle of AMV(output-2)	:	0.523
Time High of AMV(output-3)	:	0.760
Time Low of AMV(output-4)	:	0.693

V. CONCLUSION

Thus, rain sound generator which provides lovely white noise, and is excellent for the purpose of concentration and relaxing our minds is implemented. This allows people to fixate their minds to calmness and would provide them a sound sleep.

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