



OUTLINE AND IMPLEMENTATION OF A BIOMEDICAL SLEEP INDUCER

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Abstract: Nothing is as enjoyable as to relax completely whenever desired. In today's focused world mental anxiety is an intense issue. Accordingly, a sleeping disorder is happening everywhere throughout the world. The absence of peaceful rest can influence our capacity to complete everyday duties. As an outcome, this can prompt memory issues, sadness, peevishness and an expanded danger of coronary illness and car related mischances. In the vast majority of the cases, individuals utilise substantial measurement medication to dispose of this issue which is extremely unsafe to the human body. There is a much antagonistic impact in light of the fact that in one phase individuals get dependent on this. In the current time, analysts are attempting to comprehend this utilising electromagnetic field treatment. With the progression of past specialists, we have composed a device which makes and transmits an electromagnetic field through a radiator coil and makes a domain accommodating for sound rest. This paper exhibits the inspiration driving this venture and portrays the model produced for an ease and easy to use framework that battles against sleep deprivation by making an electromagnetic field.

Keywords: Radiator coil, Insomnia, electromagnetic field, Mental Anxiety, Sleeping disorder.

I. INTRODUCTION

Many individuals encounter resting soundly in common environment, into a tent or a wooden hovel. This reality is expected to the solid air as well as from our oblivious capacity to see Earth's attractive magnetic fields. Absence of soothing rest can influence our capacity to do day by day obligations since we are excessively drained or experience difficulty concentrating. Resting trouble, called sleep deprivation, can include trouble nodding off when you initially go to bed during the evening, awakening too soon in the morning, and awakening frequently amid the night. A wide range of sleep deprivation can prompt daytime sleepiness, poor focus, and the powerlessness to feel revived and rested in the morning. Magnets have been utilized for quite a long time to treat the various physical issue. A hypothesis of quickened move from attentiveness to rest is proposed to clarify the procedure of sleep deprivation help through low-quality static attractive fields. Examination by Magnetic Resonance Imaging (fMRI) is utilized to additionally research the hypothesis. Another investigation was directed by motivation attractive field treatment where 2% persistent got clear change, 24% patient got the clear cure, 6% got slight change and 49% had no prominent change. Other found brainwave excitement decades prior utilizing binaural beats (sounds) and throbbing light, in spite of the fact that it's difficult to lay down with these frameworks because of clear confinements. Our goal is to plan a gadget which will make a similar example of the wave that makes in the mind amid rest. It produces an electromagnetic field, makes less demanding to nod off, and invites a drawn out and sound rest without medications. [1][2]

II. LITERATURE REVIEW

A. Insomnia And Its Various Phase

Insomnia or restlessness is a person's accounted for dozing challenges. A meaning of a sleeping disorder is, Difficulties starting and looking after restorative, or non-restorative sleep, related with debilitations of daytime working or checked misery for over 1 month.

Insomnia can happen at any period of life: however, it is especially basic in the old ones. A sleeping disorder can be transient Insomnia (goes on for not as much as seven days) or Acute Insomnia (implies powerlessness to reliably rest soundly for a time of not as much as a month) or chronic Insomnia (goes on for more than a month) which can prompt memory issues, discouragement, peevishness and an expanded danger of coronary illness and car-related mishaps and so on. [3]

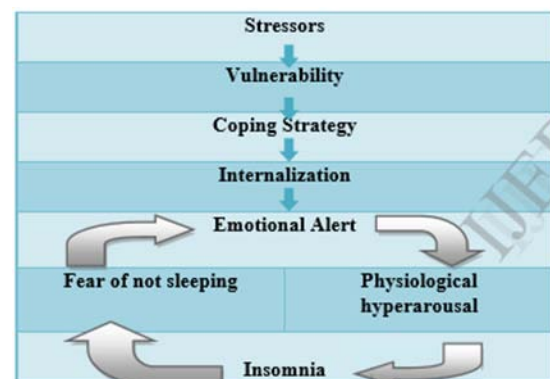


Figure 1. Flow chart (how insomnia occur)

B. Sources and Symptoms

Insomnia can occur due to following reasons:

Nocturnal Symptoms:

1. Everyday trouble in nodding off.
2. Repeated scenes of awakening due to which patient finds it difficult to induce sleep again.
3. Early morning waking up and then unable to fall asleep.
4. Non-reviving night sleep Day-time symptoms. [4]

Diurnal Symptoms:

1. Exhaustion
2. Nervousness and peevishness
3. Unhappiness
4. Tiredness. [4]

C. Division of Brain wave patterns:

- ✓ **Beta wave (14-30Hz)**
Alertness, Concentration, Arousal, Cognition.
Fights, uneasiness, sentiments of partition.

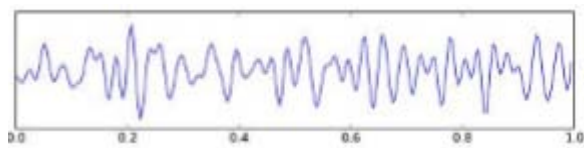


Figure 2. Beta Wave

- ✓ **Alpha wave (8-13.9Hz)**

Increased, serotonin generation, loose concentration, super learning, Relaxation.

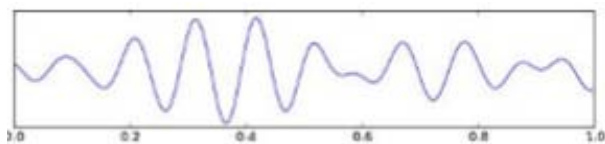


Figure 3. Alpha Wave

- ✓ **Theta wave (4-7.9Hz)**

Increased generation of catecholamine, expanded innovativeness. Rapid eye development (Dreaming rest)

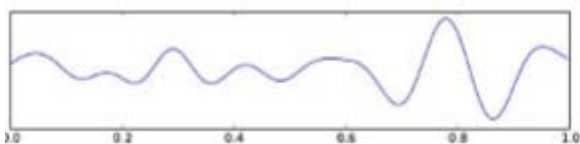


Figure 4. Theta Wave

- ✓ **Delta wave (1-3.9Hz)**

Human development hormone discharged. Non-Rapid eye development (dreamless rest) Acquiring a sentiment absence of consciousness of our substantial nearness. [5] [1]

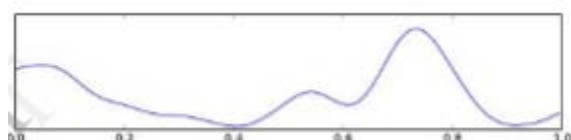


Figure 5. Delta Wave

D. The state of the human mind amid rest

After Closing our eyes, and relaxing, the dominating EEG outline will be a moderate alternation around 7 and 12 hertz. This waveform is known as “alpha rhythm” and is related with satisfaction and a diminished level of consideration. Upon wakefulness, it makes the EEG change to the beta wave, happening amid around 17 and 20 hertz. Different incidences and waveforms are found in kids, diverse stages of sleep, and different cerebrum issue, for example, epilepsy, a sleeping disorder and so on. Upon initially enter sleep, our brain waves slowdown from beta (12 to 18 Hz) to alpha (8 to 12 Hz) to theta (4 to 8 Hz). This leads to occurrence of stage one. The amplitude of rest waves is most minimal amid alertness (10-30µV) and demonstrates a dynamic increment through the different phases of rest. [6][7] Division of Brain wave patterns: The state of the human mind amid rest

Table 1. Different Phases of REM Sleep [1]

STAGE 1	STAGE 2	STAGE 3	STAGE 4	REM
1. Light Sleep	1. Eye movements & muscle activity, along with brain activity, all decrease.	1. Brain produces very slow delta waves.	1. Brain produces only delta waves.	1. Heart, breath & blood pressure rise, while muscles of the chin, limbs, neck & torso are paralyzed.
	2. Brain waves slow down.	2. Deep sleep begins.	2. Sleeper may be disoriented if awakened.	2. Eye movement is quick & irregular, and the sleeper begins to dream.

Table 2. Different Phases of Non-REM Sleep [1]

Stage N1	Stage N2	Stage N3
1. The transition of the brain wave from alpha (8-13) to theta (4-7 Hz)	1. Sleep spindles ranging from 11 to 16 Hz (most commonly 12-14 Hz).	1. This Stage called deep or slow-wave sleep. 20% delta waves ranging from 0.5-2 Hz and having a peak-to-peak amplitude >75 µV.
2. This stage is referred to as somnolence or drowsy sleep.	2. Muscular activity decreases, and consciousness disappears.	2. In this stage parasomnias such as night terrors, nocturnal enuresis, sleepwalking and somniloquy occur.
	3. This stage occupies 45-55% of total sleep in adults.	

E. Sleep timing and control:

Ordinary planning is measured by the circadian clock. This 24-hour clock: an internal punctuality, temperature-changing, catalyst monitoring gadget works couple with adenosine, a neurotransmitter that hinders a considerable lot of the real procedures related with attentiveness. Alongside comparing messages from the circadian clock, this advises the body it needs to rest. Rest balance (arousing) is principally controlled by circadian mood. A man who routinely dozes at much late night will progressively hinder this daily clock. Thus, he doesn't feel lethargic at the time or when required. Hence progressively prompts a sleeping disorder, called Insomnia. [7][3] [1]

III. METHODOLOGY

Faraday's law of electromagnetic acceptance is the fundamental guideline of this device. Which is a fundamental law of electromagnetism predicting how a magnetic field will interface with an electric circuit to create an electromotive force(EMF) a marvel called electromagnetic induction

The cerebrum is continually producing an outline of internal neural frequencies, in addition to others, electromagnetism is responsible for the modification of these waves in our surroundings. TV, Radio waves, noise from electric circuits additionally create electromagnetic occurrences. The tiny electromagnetic outlines of the Earth are also a part of our surroundings. The biosphere is encompassed by attractive fields: some produced by the earth's own magnetism, others created by planetary storms and changes in climate. These attractive fields are additionally created by electronic gadgets (e.g. engines, TVs, PCs, microwave stoves, electrical wiring in homes, electrical cables). Indeed, human body produces inconspicuous attractive fields created by reaction inside cells and ionic streams of the sensory system. An electromagnetic field (EMF) is made out of both an electric and an attractive field. The electrical field is because of the nearness of exciting particles, (for example, electrons) and the attractive field is because of the development of the exciting particles, (for example, an electron current). As of late, researchers find that exterior magnetic fields influence the body's working in equally distinctive ways.

Magnetic field treatment identifies and cures both physical as well as emotional discomfort; it alleviates indications and hinders the cycle of the new sickness. Magnets and electromagnetic treatment devices are currently utilized to kill pain, encourage therapeutic of shattered bones, and counter the impacts of stress. It has been found that an attractive field connected to the highest point of the head has a quieting, rest actuating impact on mind and body capacities, because of the incitement of the generation of the hormone melatonin. [8][9] [10]

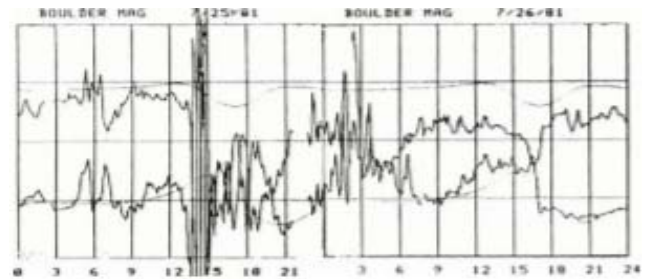


Figure 6. Earth's Geomagnetic Field [1]

➤ **Design of The Device**

The circuit/device is designed on the basis of all the theories discussed and the researches conducted, through which it is possible to battle insomnia

➤ **Circuit Illustration**

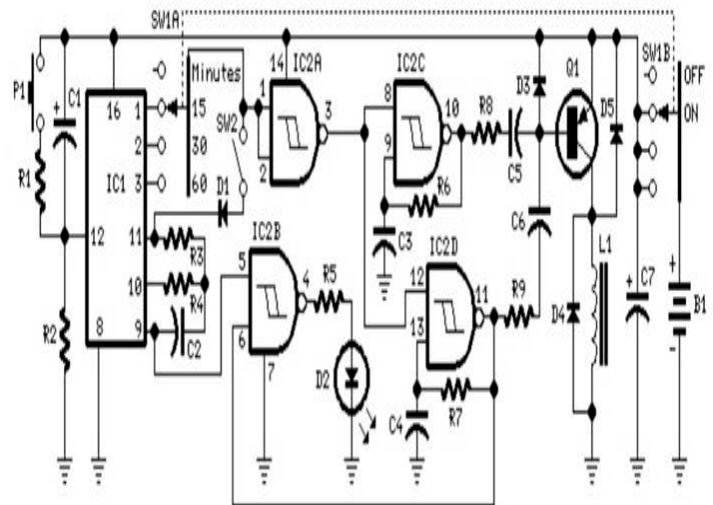


Figure 7. Circuit diagram of the device. [1]

➤ **Components Used**

The primary and main components of this device are the two IC's utilized i.e. IC 4060 and IC 4093. The determination of these IC's depends on the satisfaction of the requirements. [1]

➤ **Selection of IC 4060:**

To meet various requirement's, we have to choose such an IC which can be utilized to reset the entire operation and which additionally has a particular operation time. IC 4060 meets these two criteria. In 4060, there are three oscillators one master reset pin and ten buffer outputs Among these ten outputs, three are low and seven are high. For higher planning operation, we have to utilize low buffer output. [11] [1][2]

➤ **Selection of IC 4093:**

Here, to furnish the wave with its desired shape IC 4093 is utilized because it is great as a wave and pulse shaper. The wave shape and recurrence are obtained by differing the capacitor and resistor values. Here, outer resistors associated with pin 10 and 11 act as input ways which control the yield frequency of these pins. [11] [1][2]

➤ **WAVE SHAPE ANALYSIS**

Here, our objective is to create delta wave. Below is the specimen of the characteristic delta wave. In any case, it isn't precisely same dependably. Its form may contrast a little yet its frequency is restricted to the range of 0-5 Hz. [1]

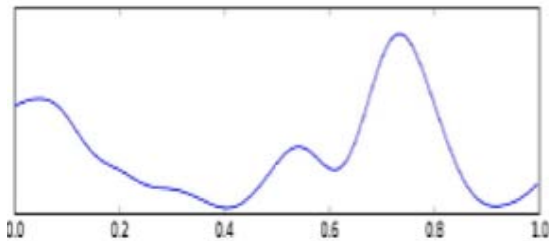


Figure 8. Standard Delta Wave

➤ **CONSTRUCTION AND WORKING OF THE CIRCUIT**

- A. A couple of square waves of frequency 1.2 and 5 Hz respectively are generated by IC 4093 which consists of IC2C and which are later on converted into 60Ms by means of capacitors C5 & C6 at same frequencies and are mixed at Q1 Base which is a transistor. This transistor is also responsible for running the Radiator coil with a scalar series of pulses of 60µS length and 9V amplitude.
- B. The timer section consists of IC1, IC2A & IC2B. Auto reset is provided by C1 and R2 at switch on. IC1 consists of internal oscillator which drives 14-stage ripple counter and after 15 mins' operation output pin 1 goes high. IC2C & IC2D oscillation stops when pin 3 of IC2a goes low.
- C. If alternate mode operation of SW2 is in action, then after 15 minutes IC1's pin 1 outputs a zero (low), oscillators are enabled again when pin 3 of IC2A goes high.
- D. If SPST button (SW2) is switched off, then IC1's pin 1 outputs a one (high). By the means of D1 internal oscillator is deactivated. As a result, the circuit remains off till the time a reset pulse is applied by P1 to pin 12. Due to which the circuit is restarted. [1] [2][12]

➤ **PROCEDURE**

- E. Timing option can be selected by means of the rotary switch SW1. Operation Mode can be of 15, 30 or 60 minutes. SW2 can be used for both "Alternate and stop mode operation" mode operation.
- F. The electromagnetic radiation terminates when the pre-set time is over, which is done by switching off the SW2.
- G. With SW2 in working mode (open) (Alternate mode operation) the circuit will work for the pre-set time, then pauses for the exact quantity of time, this cycle reoccurs for a long time. [1] [2] [12]

➤ **Points to Remember about the circuit**

The following Points should be noted:

- ✓ L1 is acquired by twisting 600 turns of 0.2 mm. enamelled wire on a 6mm measurement, 40 mm. long, steel bolts. Winding should be secured with the help of insulating tape.
- ✓ Battery life can be drastically expanded overlooking LED D2 and its related resistor R5
- ✓ Mean current drawn is about 7mA, diminishing to under 4mA amid delays when in Alternate mode operation. [1] [2]

➤ **ADVANTAGES**

- ✓ This project helps in battling sleep deprivation. aside from this it additionally supports relaxation, stress management and induces sleep easily without any usage of drugs.
- ✓ This device creates the kind of geomagnetic fields what's more, it helps the brain surrounded by a perfect condition for a sound sleep.

➤ **DISADVANTAGES**

- ✓ Due to less radiated power, it is not possible to measure the radiation using conventional instruments
- ✓ Galvanometer has been used for detection of electromagnetic field, but because of lack of flux meter in the lab accurate measurements are not possible.
- ✓ Measuring frequency is difficult in practical case by using oscilloscope.

IV. RESULTS

OUTPUT	VOLATGE (volts)	FREQUENCY (Hz)
Sleep induced signal to transistor	6	2.8
Excitation of radiator coil	8.2	2.2

Table 3. Sleep induced signal parameters

The test circuit is successful in generating the desired signal as per the standard specification. The voltage and the frequency parameters of the generated sleep inducing wave are shown in the Table 3. It can be easily seen that the induced waveform falls in the low-frequency band of EEG signals.

V. CONCLUSION AND FUTURE WORK

- ✓ Apart from fighting insomnia, which means no more medication, this project also helps to reduce stress and supports relaxation and sleep is induced easily.
- ✓ The device provides ideal environment to the brain by generating magnetic fields, which results in a sound sleep. In the future, this project can be developed more.
- ✓ The device can be made more portable and efficient by enclosing it in a plastic box.
- ✓ The output obtained is not that satisfactory due to the limited emission of magnetic field by radiator coil, hence if more research is done on this aspect it can be improved, which will make it more efficient and convenient.

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