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Design and Development of Stress Detector and Sleep Inducer

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***Abstract*— The physical strains or psychological tensions cause stress which may result in lack of human efficiency. Stress may be one of the reason for insomnia the sleep disorder, and insomnia may be one of the cause for stress. The present work deals with the design of stress detector based on the principle of variation of skin resistance in accordance with emotional states and the design of Sleep Inducer based on principle of generation of magnetic field which is almost equal to geo magnetic field. The stress measurement is performed and displayed on a scale of ten with high stress indication using red LED. The sleep inducer induces sleep in two operating modes with the preset time of about 15, 30 and 60 minutes.**

Keywords—Stress, Strain, Insomnia, Geo Magnetic Field, EEG

I. INTRODUCTION

The stress management is on the major criteria to carry the work with full efficiency and to maintain good health. The current work describes the design of stress detector model to detect the stress in ten levels.

Sleep difficulty is observed in people with health complications and stress. The sleep is usually induced using drugs with slight or moderate side effects. The present work proposes sleep inducer model which generates magnetic field perceived by the brain and creates an ideal environment for a sound and peaceful sleep.

Stress has become common condition because of several factors such as physical, mental and behavioral changes. Amount of stress can raise to acute dysfunctions and lack of human efficiency [1].

The research conducted by ASSOCHAM revealed that the stress and mental fatigue has increased in sectors comprising construction, shipping, banks, hospitals, trading houses, electronic and print media, small-scale industries, retail and card franchise etc. [2].

Prolonged stress can cause condition called distress, which can lead to physical symptoms including headaches, stomach upset, elevated blood pressure, chest pain and problems with sleeping [3].

The sleep inducer designed by Junji Matsumoto et.al[4], shows electric control circuit arranged to produce a therapeutic wave-form output at frequencies from 14 Hz to 0 Hz, adapted to a sleep indicating electroencephalogram.

Md. Mahadi Hasan et al. [5], have developed a proto type of a sleep inducer that generates an electromagnetic field to induce sleep.

II. METHODOLOGY

The stress meter is designed for detection of human emotional states and sleep inducer is designed to generate an ideal sleeping environment for an individual.

A. Stress meter

The stress detector enables the detection of emotional states of the subject. The system works on the principle of detecting the variation in skin resistance in accordance with the emotional states of the person. The resistance is inversely related to the stress experienced.

The block diagram of the stress meter is shown in figure 1.

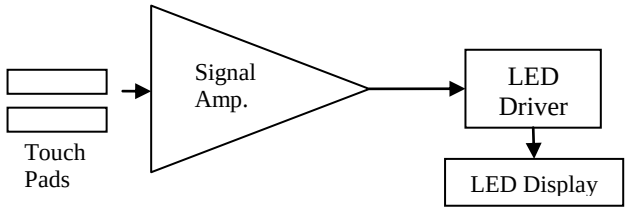

Fig 1. Block diagram of stress meter

The touch pads provide input to the stress meter. They sense the resistance of the skin of subject under different stress states. The output voltage of the touch pad is amplified in the signal amplifier unit. The amplified output is displayed on the LEDs. Each LED indicates different stress levels.

1) Touch Pads

The touch pad used for the current work is tow tinned pads made of piezoelectric substance. When these pads are

touched by a finger tip of subject, it senses the variations in skin resistance. The variation in skin resistance causes voltage variations in the pads.

2) Signal Amplifier:

Voltage variations from sensing touch pads are amplified by the transistor BC548. This transistor is configured as common emitter amplifier. The base of the transistor is connected to one of the touch pads through a resistor and the emitter terminal is grounded through a potentiometer. The sensitivity of the transistor can be adjusted using this potentiometer.

3) LED driver and display:

The LED driver circuit accepts the amplified input from signal amplifier. The display driver used in the current work is IC LM3915. It is a monolithic integrated circuit that senses the analog voltage levels and displays them through LEDs. It can be used in dot or bar display mode. It drives upto 10 LEDs with each having an increment of 125mV in input.

The different stress levels lead to different skin resistances being indicated on LED display with green LED indicating relaxed state of mind, yellow indicating intermediate state and the red LEDs indicating high stress level.

The Zener diode voltage regulator is used to provide a regulated power supply of 9V to the circuit.

B. Sleep Inducer

The sleep inducer system is designed to generate the magnetic field which is almost equal to geo-magnetic field of the earth. The signals generated by the device are perceived by brain which creates ideal environment for sleep.
The block diagram of the sleep inducer is shown in figure 2.

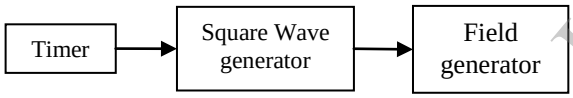

Fig 2. Block diagram of sleep inducer

The timer is used to control operation time of the circuit. The square wave generator block generates two square waves. These waves are altered to same frequency. The transistor will drive the radiator coil in the field generator block giving the required magnetic field.

1) Timer:

The timer circuit is designed to maintain the time of circuit operation to be 15, 30 or 60 minutes. The device operates for the pre set time and pauses for the same amount of time. A push button will reset the cycles. The timer circuit consists of IC 4060, two NAND gates, capacitors and resistors. The IC 4060 is high speed silicon gate CMOS 14-stage ripple carry counter with three oscillator terminals, ten buffered outputs and an overriding asynchronous master reset.

2) Square Wave generator:

The purpose of this block is the generation of two square waves at about 1.2 and 5Hz using two NAND gates. These waves are converted into 60µs at same frequency using capacitors.

The implementation of four NAND gates is achieved using IC 4093. It consists of four Schmitt trigger circuit each functioning as a two input NAND gate with Schmitt trigger action on both inputs. Each of the gate has equal source and sink currents.

3) Field generator:

The 60µs pulses generated in the square wave generator block is fed to the base of BC 327 pnp transistor for required magnetic field generation. This transistor drives the radiator coil with a scalar series of pulses of 60µs length and 9V amplitude. The radiator coil is an inductor which stores energy in the form of magnetic field. When current flowing through an inductor changes, a time varying magnetic field is created inside the coil and voltage is induced.

The whole circuit is powered by a 9V battery.

III. RESULTS AND DISCUSSION

The stress meter and sleep inducer designed in the present work is shown in figure 3 and figure 4 respectively.

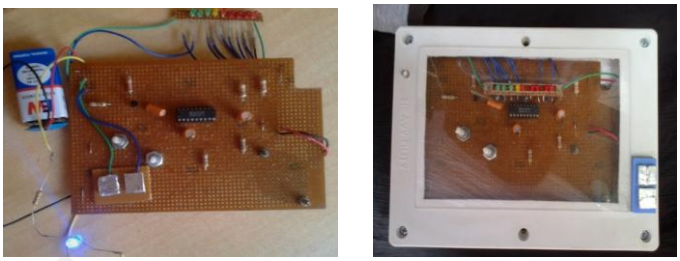

Fig 3. Developed model of stress meter

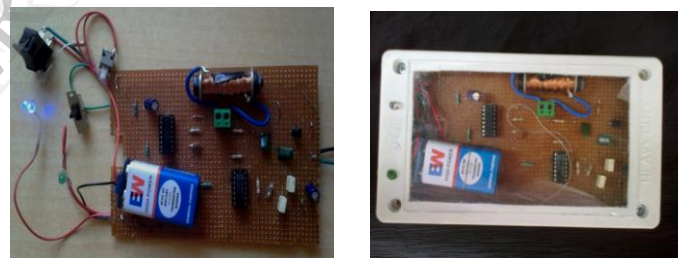

Fig 4. Developed model of sleep inducer

The stress meter indicates the stress level of the subject based on skin resistance. The skin resistance is sensed by the touchpads and converted to corresponding voltage levels, indicating the stress level. The detected stress level is indicated on LED display. Once the stress test is performed and observed stress is high, the subject may use the sleep inducer which calms the mind reducing the stress.

The recordings are made on the subjects with normal physical condition and after physical stress of climbing 30 steps. The stress meter is tested on several subjects of various stress levels and the results are found to be satisfactory.

Table I shows the observations of various subjects with their respective biological parameters and LED level indication. It has been observed from the table that after physical activity, the skin resistance values of the subjects are reduced with increased blood pressure and pulse rate.

The magnetic flux density of the sleep inducer is tested using Gauss meters. The display of Gauss meter is shown in figure 5. The Gauss meter measures the flux density at the point where its probe is placed.

TABLE I.
RECORDINGS OF PARAMETERS IN STRESS METER BEFORE AND AFTER PHYSICAL ACTIVITY
G – GREEN LED, Y – YELLOW LED, R – RED LED, BPM – BEATS PER MINUTE

Subjects	Gender	Before Physical Activity				After Physical Activity			
		Skin resistance (MΩ)	*Blood Pressure (mm Hg)*	*Pulse rate (BPM)*	*LED*	*Skin resistance (MΩ)*	*Blood Pressure (mm Hg)*	*Pulse rate (BPM)*	*LED*
Subject 1	M	5.5	131/86	62	2nd G	3.6	151/91	61	3rd R
Subject 2	M	2.7	154/93	93	3rd G	1.6	179/118	96	1st R
Subject 3	F	2.6	110/69	81	3rd G	1.8	132/85	89	1st R
Subject 4	F	6	145/96	96	2nd G	5.7	148/70	98	Y
Subject 5	F	9.6	124/76	85	2nd G	6.8	143/93	109	3rd R

Fig 5: Gauss meter

The stress meter modeled with less complexity in design and can be used easily for stress detection of any individual in all stages with visual indication using LED.

The circuit of sleep inducer is absolutely free from ambient light. It is economical and cost effective and induces a prolonged sound sleep without drugs and side effects by generating magnetic field. The LEDs are able to withstand the voltage even if no resistors are connected across it. The system helps in reducing insomnia and supports relaxation, stress management and induces peaceful sleep easily.

The sleep inducer system cannot be used with the subjects with cochlear implants, pacemaker implants, implanted pain modulators and pregnant women.

IV. CONCLUSION

The stress meter that indicates the stress level of a human being based on one's skin resistance on a scale of ten. The touchpad which is piezoelectric substance senses the skin resistance when touched with a finger and acts as the input to signal amplifier circuit. The circuit utilizes LED driver circuit to drive ten LED's with a suggested input voltage. The output stress level is indicated on LED display. The high stress level is indicated by a red LED.

If the stress test is conducted and observed stress is high, the subject may use the sleep inducer which generates magnetic field and helps the subject in reducing stress by inducing good sleep.

The designed systems can be improved by integrating the system such that detection of high stress will trigger the sleep inducer circuit with no delay. The designed models can be improved by adding a piezo buzzer, a voice recording and playback device in the circuit. The playback device can give various instructions to reduce stress of the subject, initially recorded by a medical professional. Playback voice can also include simple breathe in and breathe out exercises so that the stress level of the subject gets diminished. Additionally, an ergonomic design along with efforts can be made to minimize the area of the circuit such that the subject can easily wear the designed kit on the wrist.

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