Ambient Gamma Wave Frequency Light and Sound Source

This filing describes an electric device that produces ambient sensory stimuli at a frequency appropriate for the prevention and/or treatment of neurological or psychiatric disease.

General description
An electric device, comprising:

(a) a means for connecting to an alternating current power supply through a light socket or other electrical outlet
(b) a means for switching alternating current power supply to direct current
(c) a means for stepping-down the input voltage as necessary
(d) a means for dissipating heat
(e) a programmable or controllable means of controlling outputs including
   (1) electromagnetic radiation within the human visible light spectrum being switched on and off at a rate within the range of 25-100 Hz, and
   (2) sound with a periodic rate within the range of 25-100 Hz
(f) a means of distributing the outgoing light evenly

whereby said outputs alter the ambient light and audio environment of a room for the purpose of treating or providing prophylaxis against neurological and/or psychiatric conditions or diseases.

Specific description: multiple different variations possible, as discussed below
An electric device, comprising:

(a) an E26 lamp base for electrical connection to a 110-220 V alternating current power supply
(b) power switching supplies for switching and stepping-down the power supply to 12 V direct current, and either 5 V or 3.3 V direct current
(c) a heat-spreader and/or thermally-conductive vias and thermal pads in the PCB for dissipating heat
(d) a housing appropriate for heat dissipation
(e) a MOSFET (metal-oxide-semiconductor field-effect transistor) switching circuit for managing the 12 V load
(f) an AVR 8-pin 20 MHz 8K ATtiny85-20PU microcontroller running C++ code for controlling outputs including
   (1) a series-parallel circuit comprised of 4 parallel sets of components, each being comprised of three 5730 3000K SMD light emitting diodes (LEDs) and three 4.7 Ohm resistors in series, connected to the 12 V MOSFET-gated supply producing electromagnetic radiation within the human visible light spectrum being switched on and off at a rate of 40 Hz, and
   (2) two piezoelectric ceramic elements or diaphragms each in series with a 100 Ohm resistor supplied with electricity from individual pins in the lower-voltage circuit to produce sound with a periodic rate of 40 Hz
(g) a lens and/or diffusor for the even distribution of outgoing light

whereby said outputs alter the ambient light and audio environment of a room for the purpose of treating or providing prophylaxis against amyloid-β protein deposition in the brain, a pathophysiologic contributor to the development of Alzheimer's disease.

Design variations

Multiple variations on the above design could produce a satisfactory result. Different types of integrated circuits (IC) could be used to manage the device specifications. The circuit could employ a programmable, adjustable, or controllable driver rather than a microcontroller in combination with the means of adjusting voltage and current. In such a case, a higher voltage could be maintained throughout (would usually still need to be stepped-down from source voltage and switched to DC), which would require fewer LEDs in parallel, and would allow the incorporation of multiple LEDs in series. Low voltage (e.g. 3.3 V or 5 V) circuits could be employed, but would be limited by low luminosity and limitation to low current LEDs. With the microcontroller design, higher voltage circuits could be used to good effect using a similar transistor setup.

In the case that a microcontroller is used, any microcontroller of acceptable dimensions could be employed; examples include Arduino Nano and ATtiny84 or ATtiny85, but an abundance of suitable options and available cores exists. Use of a microcontroller provides the benefit of great versatility in sequence control or manipulation. An external crystal may be used as necessary. At the time of provisional patent filing, completed prototypes included one with an Arduino Nano, two piezoelectric diaphragms, and ten through-hole LEDs on a solderless breadboard; and one with an ATtiny85-20PU, two piezoelectric diaphragms, and twelve SMD LEDs on a custom PCB (printed circuit board). The ATtiny85 was programmed using Arduino as ISP (in-system programming) without a bootloader with the internal 8 MHz clock. Different coding approaches in a variety of languages could be used to good effect. The schematic of the circuit and PCB layout used in this iteration are attached hereto as *Exhibit A*.

Light production

A variety of light-producing elements could be used, from multiple types of LEDs to fluorescent and incandescent options, though the latter two would be prone to less consistency and inferior longevity in comparison to LEDs. If a fluorescent light source was desired, a ballast would be required in place of the driver and/or power switching supply. Different types of LEDs that could be employed include through-hole LEDs, surface mount (SMD) LEDs, and high-power LEDs. Bi-color and RGB LEDs would possess unnecessary characteristics, and would have lesser cost-effectiveness. SMD LEDs are desirable for their affordability, compactness, and favorable luminosity and color temperature ratings available. Any desired combination of luminosity and color temperature could be employed. In the case that high-power LEDs are used, fewer would be required to produce the same total luminosity, this in turn would require fewer pins on the microcontroller permitting use of a smaller variety; however, even greater attention would need to be paid to heat dissipation. Any number of appropriate resistor arrangements could be employed.

Sound production

Many types of sound-producing components could be employed. These include, but are not limited to, piezoelectric elements, buzzers, electrodynamic loudspeakers, ribbon speakers, planar magnetic speakers, electrostatic speakers, and flat-panel diaphragm speakers. Attempts to use plasma arc speakers would be complicated and would produce an unreliable product. Piezoelectric diaphragms provide a favorable combination of low cost, compact/thin physical dimensions, robustness suitable for repetitive use, and simple design with few components prone to failure.

Additional variables

There are also a variety of ways in which the power supply could be altered to meet the needs of the device. This includes, but is not limited to, power switching supplies, linear power supplies, ringing choke converters with switched-mode power supplies, or those with flyback topology, and transformerless power supplies [1].

Any variety of electrical connection to the power source could be used. This includes many different types of lamp bases if the device is to be supplied by a light socket. If the device is to be powered by another electrical outlet, a plug with prongs appropriate for the localities of distribution could be used.

Housing and light diffusor shape, size, and opacity will vary depending on aesthetic, required light distribution, and space limitations of the setting of use. The housing will contain holes whereby the auditory stimulus can be transmitted.

Another option besides an ambient source would be a wearable device. This would likely take the form of modified glasses or headgear producing gamma frequency sensory stimuli. This would have the advantages of permitting individual use, and being portable. There would also be the potential advantage of incorporating other forms of stimuli such as tactile and olfactory. It would be limited by the cumbersomeness of wearing a device that would necessarily consist of somewhat bulky components, and by the need for a battery energy source. This may also interfere with the user's ability to focus on other tasks; which would be one of the potential advantages of an ambient source.

Scientific basis

The scientific basis for this device is founded in recent research elucidating the relationship between neural synchronization and Alzheimer's disease, and the effectiveness of gamma entrainment using sensory stimulus (GENUS) in the activation of microglia and reduction of amyloid deposition in the brains of mouse models; some effects on Tau protein tangles has also been noted [2]–[4]. Studies are currently being undertaken in humans, and the effectiveness of GENUS in treating other conditions such as traumatic brain injury, and schizophrenia is yet to be explored. These research developments make this an appropriate time to begin development of this device to ensure that if/when a benefit is shown in humans without significant adverse effects, there will be a device ready for marketing which can meet the needs of those suffering or hoping to avoid future deterioration.

References

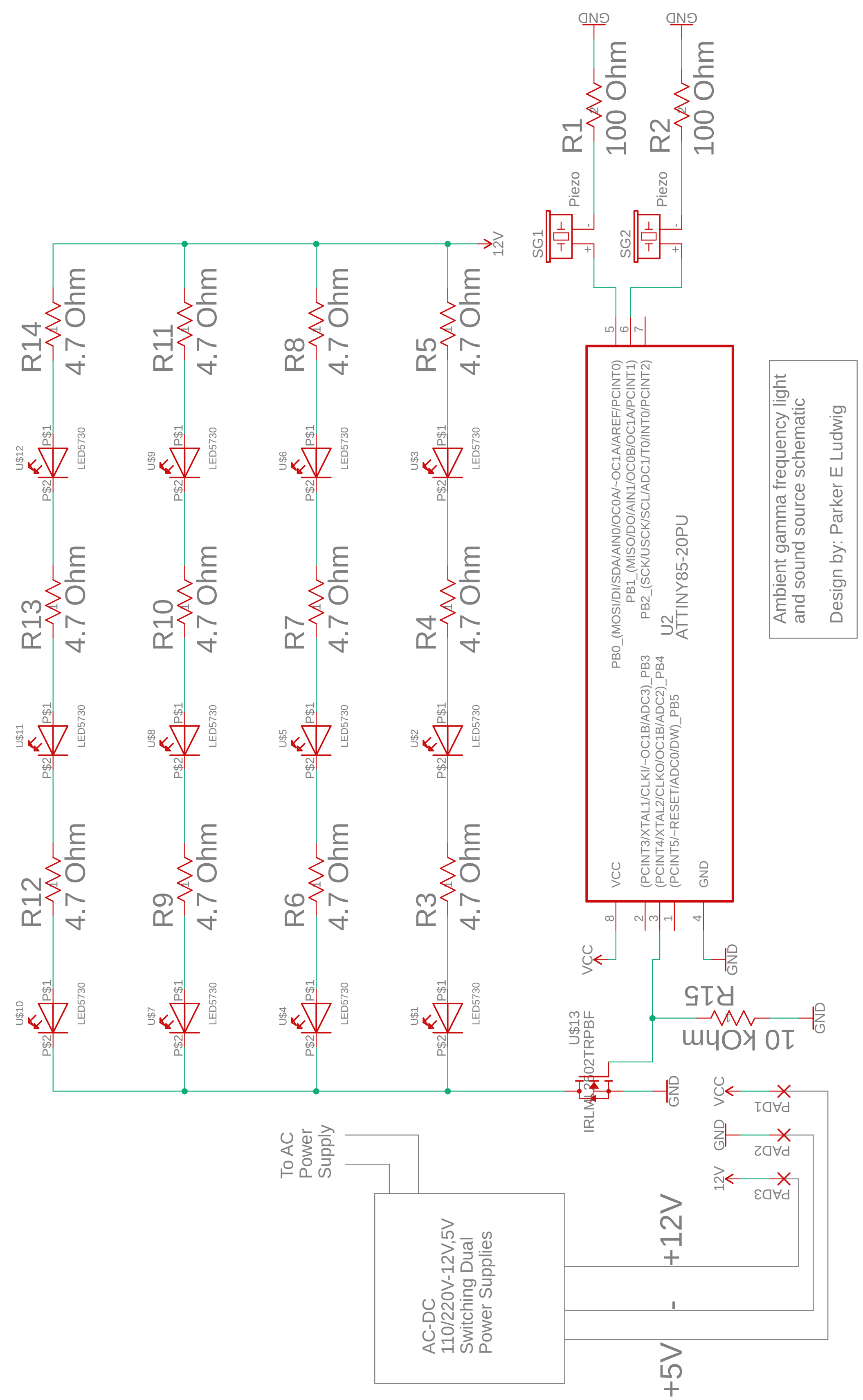
[1] "AN954, Transformerless Power Supplies: Resistive and Capacitive," p. 14, 2004.

[2] L. Aron and B. A. Yankner, "Neurodegenerative disorders: Neural synchronization in Alzheimer's disease," *Nature*, vol. 540, no. 7632, pp. 207–208, Dec. 2016.

[3] H. F. Iaccarino *et al.*, "Gamma frequency entrainment attenuates amyloid load and modifies microglia," *Nature*, vol. 540, no. 7632, pp. 230–235, Dec. 2016.

[4] A. J. Martorell *et al.*, "Multi-sensory Gamma Stimulation Ameliorates Alzheimer's-Associated Pathology and Improves Cognition," *Cell*, vol. 177, no. 2, pp. 256-271.e22, Apr. 2019.

Exhibit A.1



R1
100 Ohm
R2
100 Ohm
GND
GND
Piezo
Piezo
SG1
SG2
12V
R14
4.7 Ohm
R13
4.7 Ohm
R12
4.7 Ohm
R11
4.7 Ohm
R10
4.7 Ohm
R9
4.7 Ohm
R8
4.7 Ohm
R7
4.7 Ohm
R6
4.7 Ohm
R5
4.7 Ohm
R4
4.7 Ohm
R3
4.7 Ohm
LED5730
P$1
P$2
U$1
U$2
U$3
U$4
U$5
U$6
U$7
U$8
U$9
U$10
U$11
U$12
PB0_(MOSI/DI/SDA/AIN0/OC0A/~OC1A/AREF/PCINT0)
PB1_(MISO/DO/AIN1/OC0B/OC1A/PCINT1)
PB2_(SCK/USCK/SCL/ADC1/T0/INT0/PCINT2)
U2
ATTINY85-20PU
VCC
(PCINT3/XTAL1/CLKI/~OC1B/ADC3)_PB3
(PCINT4/XTAL2/CLKO/OC1B/ADC2)_PB4
(PCINT5/~RESET/ADC0/DW)_PB5
GND
Ambient gamma frequency light
and sound source schematic
Design by: Parker E Ludwig
VCC
GND
R15
10 kOhm
GND
U$13
GND
To AC
Power
Supply
AC-DC
110/220V-12V,5V
Switching Dual
Power Supplies
+12V
-
+5V
VCC
PAD1
GND
PAD2
12V
PAD3

Exhibit A.2