Logorithmic Volume Display

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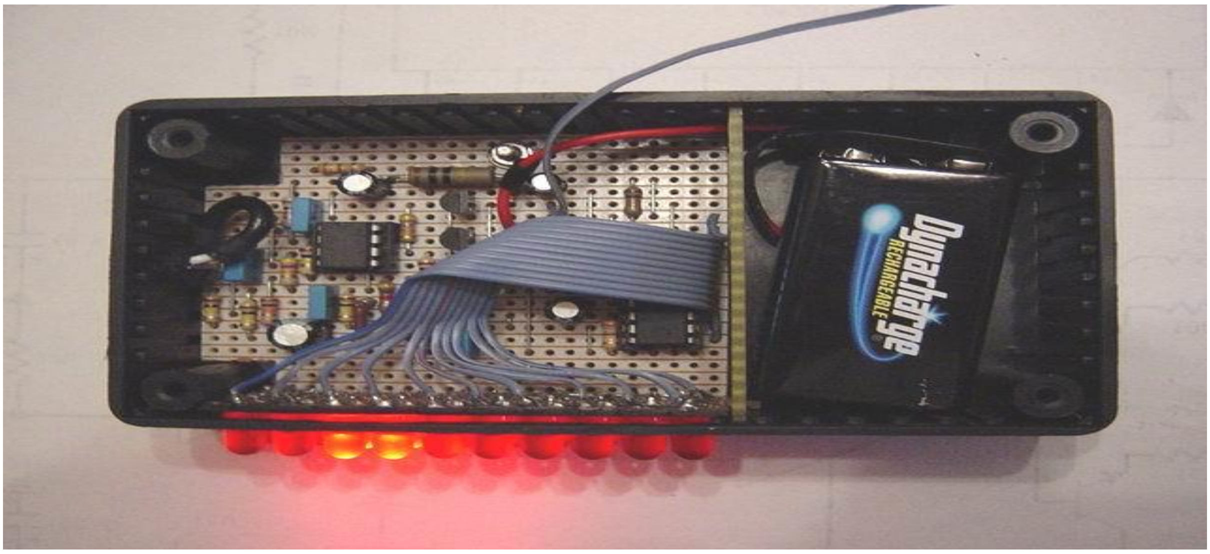
ABSTRACT

A volumetric display device is a graphic display device that forms a visual representation of an object in three physical dimensions, as opposed to the planar image of traditional screens that simulate depth through a number of different visual effects. One definition offered by pioneers in the field is that volumetric displays create 3D imagery via the emission, scattering, or relaying of illumination from well-defined regions in (x ,y ,z) space. Though there is no consensus among researchers in the field, it may be reasonable to admit holographic and highly multiview displays to the volumetric display family if they do a reasonable job of projecting a three-dimensional light field within a volume.

Most, if not all, volumetric 3D displays are either autostereoscopic or automultiscopic; that is, they create 3D imagery visible to the unaided eye. Note that some display technologists reserve the term "autostereoscopic" for flat-panel spatially multiplexed parallax displays, such as lenticular-sheet displays. However, nearly all 3D displays other than those requiring headwear, e.g. stereo goggles and stereo head-mounted displays, are autostereoscopic. Therefore, a very broad group of display architectures are properly deemed autostereoscopic.

Volumetric 3D displays embody just one family of 3D displays in general. Other types of 3D displays are: stereograms / stereoscopes, view-sequential displays, electro-holographic displays, parallax "two view" displays and parallax panoramagrams (which are typically spatially multiplexed systems such as lenticular-sheet displays and parallax barrier displays), re-imaging systems, and others.



INTRODUCTION

Types of logarithmic volume display

1. Swept-volume display
2. Static-volume display

Swept-volume display

Swept-surface (or "swept-volume") volumetric 3D displays rely on the human persistence of vision to fuse a series of slices of the 3D object into a single 3D image. A variety of swept-volume displays have been created.

For example, the 3D scene is computationally decomposed into a series of "slices", which can be rectangular, disc-shaped, or helically cross-sectioned, whereupon they are projected onto or from a display surface undergoing motion. The image on the 2D surface (created by projection onto the surface, LEDs embedded in the surface, or other techniques) changes as the surface moves or rotates. Due to the persistence of vision, humans perceive a continuous volume of light. The display surface can be reflective, transmissive, or a combination of both.

Another type of 3D display that is a candidate member of the class of swept-volume 3D displays is the varifocal mirror architecture. One of the first references to this type of system is from 1966, in which a vibrating mirrored drumhead reflects a series of patterns from a high-frame-rate 2D image source, such as a vector display, to a corresponding set of depth surfaces.

Static-volume display

So-called "static-volume" volumetric 3D displays create imagery without any macroscopic moving parts in the image volume. It is unclear whether the rest of the system must remain stationary for membership in this display class to be viable.

This is probably the most "direct" form of volumetric display. In the simplest case, an addressable volume of space is created out of active elements that are transparent in the *off* state but are either solid or bright in the *on* state. When the elements (called voxels) are activated, they show a solid model within the space of the display.

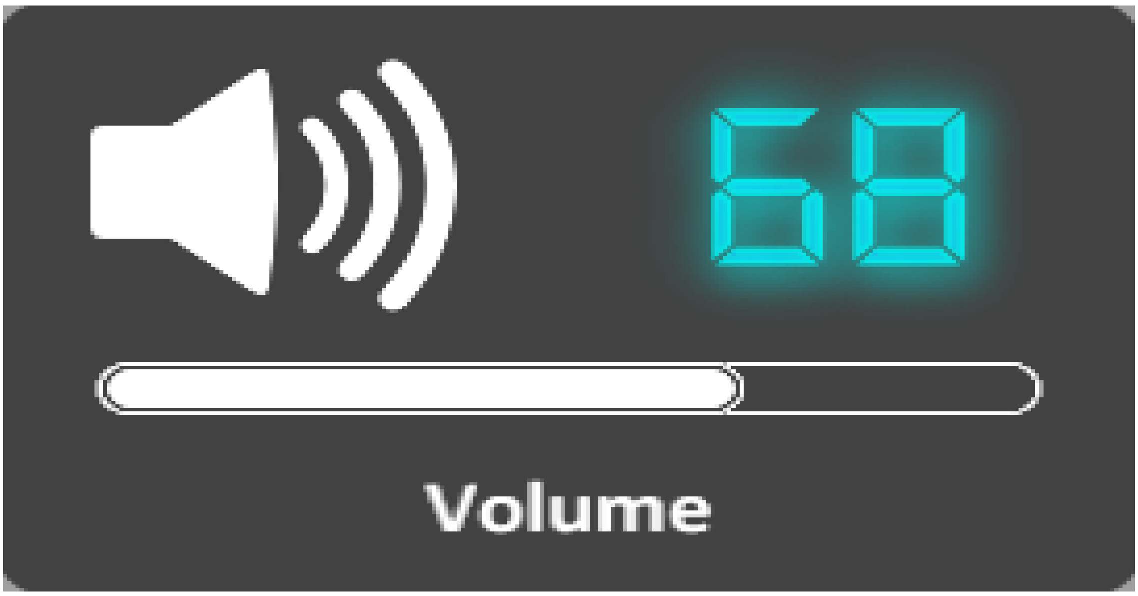
Several static-volume volumetric 3D displays use laser light to support visible radiation in a solid, liquid, or gas. For example, some researchers have relied on two-step upconversion within a rare-earth-doped material when illuminated by intersecting infrared laser beams of the suitable frequencies.

Recent advances have focused on non-tangible (free-space) implementations of the static-volume category, which might ultimately allow direct interface with the display. For instance, a fog display using multiple projectors can render a 3D image in a volume of space, resulting in a static-volume volumetric display.

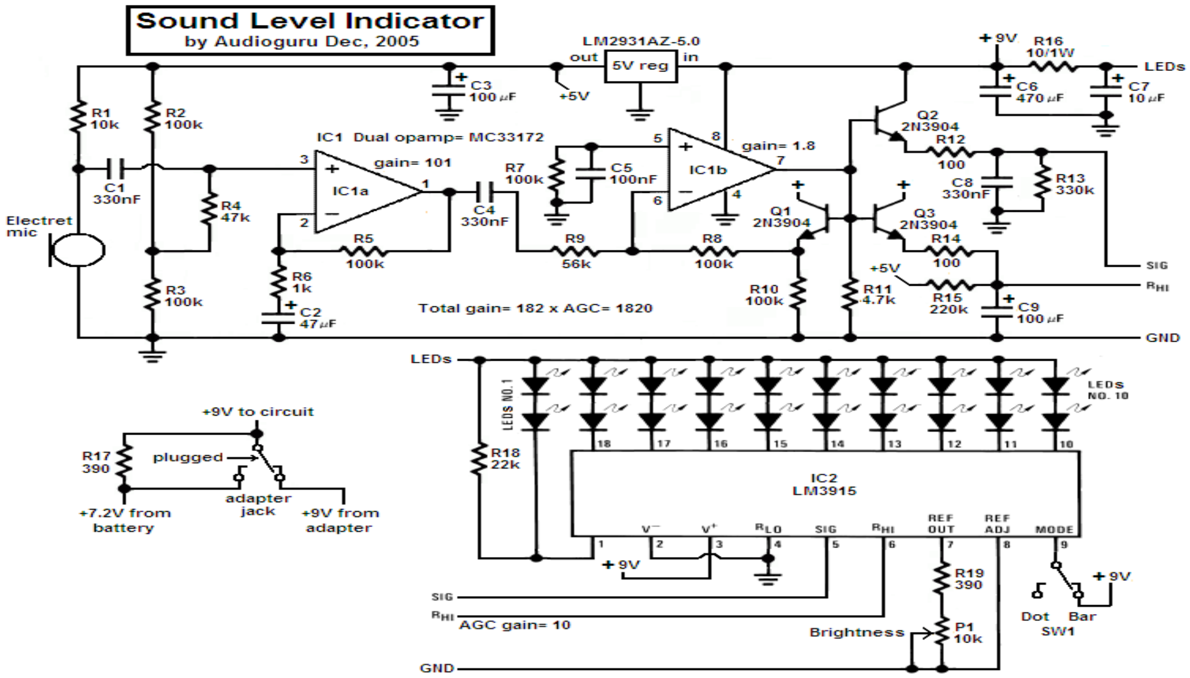
A procedure presented in 2006 does away with the display medium altogether, using a focused pulsed infrared laser (about 100 pulses per second; each eternal a nanosecond) to create balls of bright plasmaat the focal point in normal air. The focal point is directed by two moving mirrors and a descending lens, allowing it to draw shapes in the air. Each pulse creates a popping sound, so the device crackles as it runs. Presently it can generate dots anywhere within a cubic metre. It is thought that the device could be scaled up to any size, allowing 3D images to be generated in the sky.

Later modifications such as the use of an neon/argon/xenon/helium gas mix similar to a plasma globe and a rapid gas recycling system employing a hood and vacuum pumps could allow this technology to achieve two-colour (R/W) and possibly RGB imagery by changing the pulse width and intensity of each pulse to tune the emanation spectra of the luminous plasma body.

In 2017, a new display known as the "3D Light PAD" was published . The display's medium consists of a class of photoactivatable molecules (known as spirhodamines) and digital light-processing (DLP) technology to breed structured light in three dimensions. The technique bypasses the need to use high-powered lasers and the invention of plasma, which alleviates concerns for safety and spectacularly improves the convenience of the three-dimensional displays. UV-light and green-light patterns are aimed at the dye solution, which initiates photoactivation and thus creates the "on" voxel. The device is capable of displaying a minimal voxel size of 0.68 mm^3, with 200 μm resolution, and good stability over hundreds of on–off cycles.



Circuit



Circuit Description

1. The electret microphone is powered by and has a load of R1 from an LM2931 5V low-dropout regulator.
2. The 1st opamp stage is an audio preamp with a gain of 101.
3. The 2nd opamp stage is a single-supply opamp which works fine with its inputs and output at ground and is used as a rectifier driver with a gain of 1.8. It is biased at ground. Since it is inverting, when its input swings negative, its output swings positive.

4. Three 2N3904 transistors are used as emitter-followers:

    - Q1 is inside the negative feedback loop of the 2nd opamp as a voltage reference for the other two transistors. Hopefully the transistors match each other.
    - Q2 emitter-follower transistor quickly charges C8 which discharges slower into R13 and is used as a peak detector.
    - Q3 transistor is the automatic gain control. It is also a peak detector but has slower charge and discharge times. It drives the comparators' resistor ladder in the LM3915 to determine how sensitive it is. R15 from +5V is in a voltage divider with the ladder's total resistance of about 25k and provides the top of the ladder with about +0.51V when there is a very low sound level detected. Loud sounds cause Q3 to drive the top of the ladder to 5.1V for reduced sensitivity.

5. The LM3915 regulates the current for the LEDs so they don't need current-limiting resistors. In the bar mode with all LEDs lit then the LM3915 gets hot so the 10 ohm/1W resistor R16 shares the heat.

Construction

1. The stripboard layout was designed for a Hammond 1591B plastic box with space in the lower end for a rechargeable 9V battery. One bolt holds the circuit board and a second bolt was cut short as a guide.
2. A second piece of stripboard was used on a diagonal to space the LEDs closely together. A few LEDs needed their rim to be filed slightly to fit.
3. A third piece of stripboard was used as a separating wall for the battery and it interlocks with the LEDs stripboard to hold it in place.
4. 11-wire flexible ribbon cable connects to the LEDs.
5. Use shielded audio from the microphone and a rubber grommet holding it.

Parts List

- R1–10k
- R2, R3, R5, R7, R8, R10–100k
- R4–47k
- R6–1k
- R9–56k
- R11–4.7k
- R12, R14–100
- R13–330k
- R15–220k
- R16–10/1W
- R17, R19–390
- R18–22k
- P1–10k audio-taper (log) pot
- C1, C4, C8–330nF
- C2–47uF/10V
- C3, C9–100uF/10V
- C5–100nF
- C6–470uF/16V
- C7–10uF/16V
- IC1–MC33172P
- IC2–LM3915P
- 5V reg–LM2931AZ5.0
- LEDs–MV8191 super-red diffused
- Electret microphone–two-wire type Box–Hammond 1591B
- Battery–12V Ni-Cad or Ni-MH
- SW1–SPST switch
- Adapter jack–switched