Ilkogretim Online - Elementary Education Online, 2020; Vol 19 (Issue 2): pp. 1809-1816
http://ilkogretim-online.org
doi: 10.17051/ilkonline.2020.02.696764

Design And Development Of Holographic Fan

[1]Dr. C. PRIYA , [2]V.Chithra , [3]Sanjay B , [4]M.Aniruthan

[1]Associate Professor, [2]Assistant Professor Department of EEE, Sri Sairam Engineering College, Chennai-44.

[3]Master Student, Automotive Software Engineering, Technical University of Chemnitz, Germany.

[4]Assistant System Engineer (Development) Tata Consultancy Services.

Abstract

Holographic fans are types of displays that produce a 3-dimensional image seemingly floating in the air using the principle of POV (Persistence of Vision), using strips of RGB LEDs attached to the blades of the fan and a control-unit lighting up the pixels. As the fan rotates the display produces a full picture. In a time where augmented reality applications have risen to great popularity, there is a void for Augmented Reality (AR) effect. With a holographic fan, this can be achieved without any gadgets on the observer. These kinds of holographic fans are useful for advertisement and/or advisory purposes in public areas, as examples of shopping malls, airports, fares or other public buildings and also to create awareness.

Keywords: Holographic fan, Persistence of vision, Augmented Reality

1. INTRODUCTION

Holography was invented in 1947 by the Hungarian-British physicist Dennis Gabor work for which he received the Nobel Prize in Physics in 1971. Pioneering work in the field of physics by other scientists including Mieczysław Wolfke resolved technical issues that previously had prevented advancement. The discovery was an unexpected result of research into improving electron microscopes at the British Thomson-Houston Company in Rugby, England, and the company filed a patent in December 1947 (patent GB685286).

The optical holography did not really advance until the development of the laser in 1960. The development of the laser enabled the first practical optical holograms that recorded 3D objects to be made in 1962 by Yuri Denisyuk in the Soviet Union and by Emmett Leith and Juris Upatnieks at University of Michigan, USA

People live today in a communication society where information exchange widely relies on visual representation, It is amazing that most of the screens used plenty of hours per day for work or entertainment get along with a 2D image. Generally complex data can be interpreted more effectively when displayed in three dimensions. In the information display industry, three-dimensional (3D) imaging, display, and visualization are therefore considered to be one of the key technology developments that will enter our daily life in the near future. Recording and reconstruction of a color holographic image by using digital lensless Fourier transform holography is discuused in [5].

Natural perception of depth as in daily life, however, remains still a challenging task in display technology as much as for content creation. This involves display performance, eye visual acuity, and visual perception. The purpose of this report is to review current 3D display technologies, and especially how they provide crucial depth cues.

Holography (from the Greek , "whole" + "writing, drawing") is a technique that allows the light scattered (reflected) from an object to be recorded and later reconstructed so that when an imaging system (a camera or an eye) is placed in the reconstructed beam, an image of the object will be seen even when the object is no longer present. The image changes as the position and orientation of the viewing system changes in exactly the same way as if the object were still present, thus making the image appear three-dimensional. 3DHolograph Projection -Future of Visual Communication is discussed in [6]. Computer- generated holograms for 3D display is discussed in [8]. Capture, processing, and display of real-world 3D objects using digital holography is discussed in [10]

Holography is the only visual recording and a playback process that can record our three-dimensional world on a two dimensional recording medium and playback the original object or scene to the unaided eyes as a three dimensional image. The image demonstrates complete parallax and depth-of- field and floats in space either behind, in front of, or straddling the recording medium. The technique of holography can also be used to optically store, retrieve, and process information. Figure 1 shows the timeline of holography development. Color electro-holography by three colored reference lights simultaneously incident upon one hologram panel is discussed in [4]. recent improvements in holograms for three-dimensional display is discussed in [7].

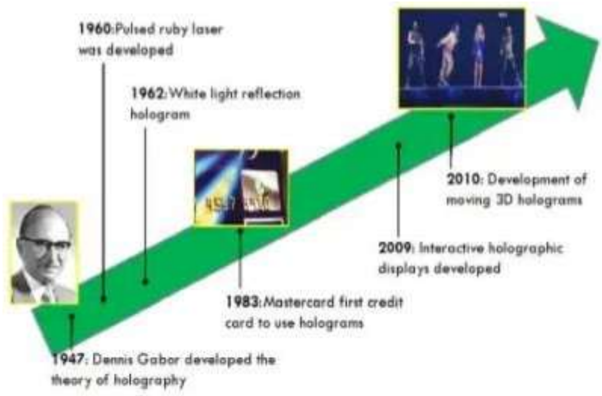

Figure 1: Timeline of holography

2. METHODOLOGY

2a. PERSISTENCE OF VISION

Persistence of vision refers to the optical illusion whereby multiple discrete images blend into a single image in the humanmind. Figure 2 shows the image explaining the persistence of vision. Our eyes offer one of the five specialized means by which our mind is able to form a picture of the world. The eye is a remarkable instrument, having certain characteristics to help us process the light we see in such a way that our mind can create meaning from it.

Take the motion picture, the scanning of an image for television, and the sequential reproduction of the flickering visual images they produce. These work in part because of an optical phenomenon that has been called persistence of vision and its psychological partner, the phi phenomenon; the mental bridge that the mind forms to conceptually complete the gaps betweenthe frames or pictures. Holographic Projection Technology is discussed in [9].

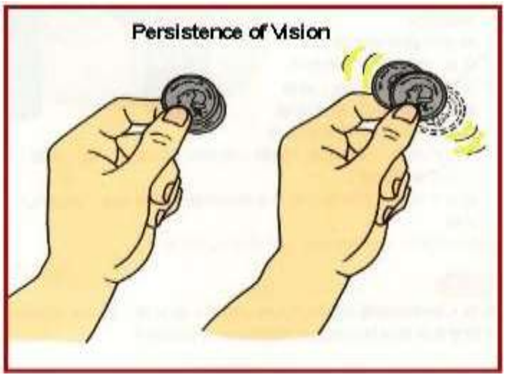

Figure 2: Persistence of Vision

2b. HOLOGRAPHY WORKING

Holography is the lens of photography in which an image is captured not as an image focused on film, but as an interference pattern at the film. Typically, coherent light from a laser is reflected from an object and combined at the film with light from a reference beam. This recorded interference pattern actually contains much more information than a focused image, and enables the viewer to view a true three-dimensional image which exhibits parallax. That is the image will change its appearance if you look at it from a different angle just as if you were looking at a real 3D object.

Holograms are recorded using a flash of light that illuminates a scene and then imprints on a recording medium, much in the way a photograph is recorded. A hologram, however, requires a laser as the light source, since lasers can be precisely controlled and have a fixed wavelength, unlike white light, which contains many different wavelengths. holograms primarily produced to show objects in 3D [3].

3. BLOCK DIAGRAM:

Figure 3 shows the block diagram of the holographic fan.

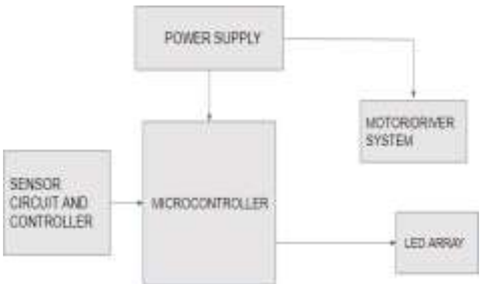

Figure 3: Block Diagram

The hardware components present are Arduino (microcontroller), Motor, LED Strip, Power Bank (power supply), Hall effect sensor, Magnet, resistors, USB Wire, 4 way Electrical Connector Strip (Block Terminal), Jumpers male – male, Jumpers male – female.

3a. LED STRIP APA102

Figure 4 shows the image of the LED strip APA102. The APA102 led strip has 2 wires for sending data - one clock pin and one data pin. That means two pins are required to control the strip.

You can use any microcontroller or microprocessor, including Arduino, Raspberry Pi, BeagleBone, Propeller, Spark Core, and any 'raw' microcontrollers/microprocessors to control the strip. It's very easy to port the library, and you can send data to the pixels at up to 32 MHz clock rate!

Figure 4: APA102

3b.ARDUINO.

Persistance of vision using Aurduino is discuued in [1, 2]. Figure 5 shoes the image of the Arduino Uno microcontroller which is a 8-bit ATmega328P microcontroller. Along with ATmega328P, it consists of other components such as crystal oscillator, serial communication, voltage regulator, etc. to support the microcontroller. Arduino Uno has 14 digital input/output pins (out of which 6 can be used as PWM outputs), 6 analog input pins, a USB connection, A Power barrel jack, an ICSP header and a reset button.when a person sees an object, its image remains in the retina of the eye for a time interval of 1/16th of a second. This phenomenon is known as persistence of vision. This phenomenon is used in the LED POV Display to form images.We turn the LEDs on and off in such a way that the different images overlap each other forming letters and characters. Lets take an example of the letter E (in the above figure)to be displayed on the POV Display.

1 2 3 <– Time

1 1 1 <– LED 1

1 0 0 <– LED 2

1 1 1 <– LED 3

1 0 0 <– LED 4

1 1 1 <– LED 5

Each row represents the 5 LEDs we use to make the Arduino POV display and each column is a time interval. Each element inthe row represents the state of the LED at that given time.

At time = 1 : LED 1,2,3,4,5 are ON At time = 2 : LED 1,3,5 are ONAt time = 3 : LED 1,3,5 are ON

This way we can visually see the letter E formed by the LEDs but the time interval would be very small in milliseconds. Due to the short time intervals and the ability of the LEDs to turn ON and OFF very quickly we can see the letter E as all the 3 images merge.

Figure 5: Arduino

The image is going to be created from a spinning ray of RGB LEDs, controlled by some PWM drivers and of course, amicrocontroller which will rule everything.

All these components should be attached to the rotor ofa motor which will rotate at about 1200rpm. The first step is to determine the rotation speed needed to achieve the persistence of vision. This can already be achieved at around 4 rotations persecond, or 320 rpm. This is the first requirement for our motor.

Among the most important characteristics, it should be commented that a Holographic Fan is easy to install and totally light, but also it is a fragile model and, therefore, must be kept at a distance. The elements to take into account are the number of LED pieces that allow the projected images to be viewed and their resolution, their hours of useful life, the voltage used, energy saving, their angle of rotation, and finally is necessary to mention that it supports several formats of images.

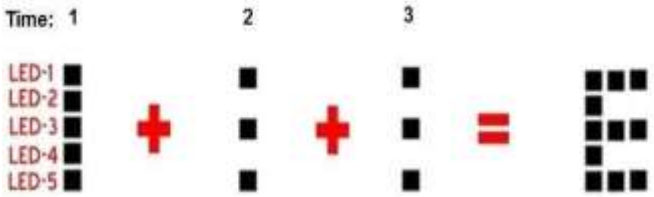

Figure 6: How it Works?

The next requirement is that it should have enough torque. The torque is important, since it will influence the speed at which the rotation arm accelerates; it should come to full speed in a reasonable amount of time.

T = I a

* T is the torque of the motor

* I is the moment of inertia of the arm

* a is the angular acceleration

To get the acceleration time, we can integrate this formula int(T dt) = int(I a dt)T t = I v (where v = angular velocity of the motor = 320 rpm)

t = I v / T

For a torque of about 4500 gcm (0.44 Nm), we get an acceptable time of about 14 seconds.

The conclusion is, our motor needs at least 320 rpm and 4500 gcm,This way T period of each rotation is determined and thus the period of each sector is calculated by the following formula: T/n. This ensures that even at unstable RPM, the image will be stationary and synched. Figure 7 shows the prototype of the Holographic fan.

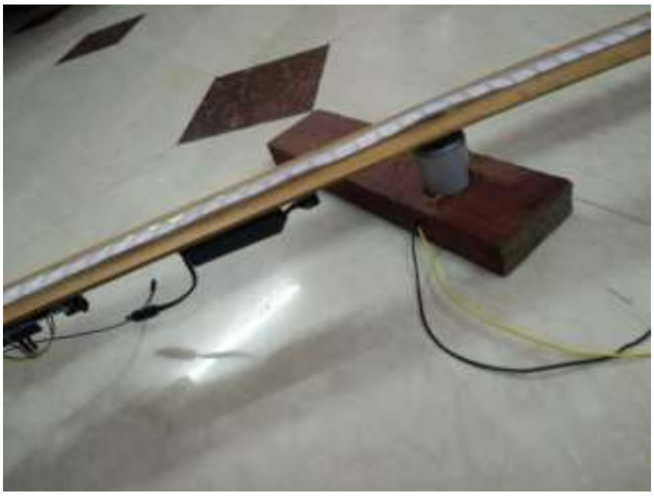

Figure 7: Prototype

Conclusion:

Holographic fans are used to produce a 3 dimensional image using the principle of Persistence of Vision. Prototype of the holographic fan has been done. The image produced using this 3D holographic fan can be usedfor marketing. It can also be used in education wherein teacher can be made to be present in the classroom virtually. Students stated that the application of the holographic device in biology class was very interesting because they considered that it is more important to see an object than just imagine it.

This is also used in the entertainment industry in the movies and music concerts. In these movies, peoplerelate with holograms as they would relate with real humans. Although, what people see in these movies are not real holograms, they depict what a real hologram looks like and future capabilities of holography. In the case ofmusical industry, the musicians can be far away in New York while performing in several cities around the world. Holography technology can be used for projection displays. Overall this device can be sued to highlight products,create awareness, give guidance or safety information.

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