

Claims

What is claimed is:

1. A free space “pop-out” & “sink-in” hologram device which contains the free space “pop-out” & “sink-in” hologram display panel which generates, creates and displays a free space “pop-out” & “sink-in” hologram on the surface of or top of or inside of or part on top and part inside of the hologram display panel which is also capable of displaying free space “pop-out” & “sink-in” holograms of “pop out” or “sink in” 3D Augmented reality (AR), Virtual reality (VR) & mixed (MR) reality, is made and contains one or a combination of different layers containing special material having different optical properties and features, where in a Liquid Crystal Display (LCD) based or any type of Light Emitting Diode (LED) based or Electronic paper based or Digital Paper based or light based or Cathode Ray Tube (CRT) based display, electronic paper based display, pixelated based display or any type of pixelated based display, pixelated images & photos based or pixelated video based illuminated picture or illuminated photo, there are special material layers with special properties and features attached on to the top of the display. The multi-layered structure built on the display generates the hologram in free space. The multi layer structure may contains one or a combination of the following:

optical focussing layer & structure, optical lens array, optical refractive layer & structure, optical diffraction layer, Optical guide layer and structure, optical total internal reflection structure layer, optical total internal reflection layer, Optical spacer layer, diverging optics layer, converging optics layer, lenticular optics layer, array of optical total internal reflective structures, adhesive layers, optical coupling layers, optical adhesive coupling layers, electro magnetic or electro static actuators for fine tuning of hologram, hydraulic or pneumatic actuator for fine tuning of hologram, mobile phone communication hardware, antenna for wireless communication, batteries, cellular network hardware & software, magnetic field inducer array, single or multiple cameras for eye tracking, Display with an array of pixels, Backlight for display illumination, Backlight illumination with quantum dots, Colour filter and filter array, Camera capable of capturing 3D hologram quality fully focussed images and videos, spatial audio which enhance the free space “pop-out” & “sink-in” hologram experience whereby simulating real life auditory effects.

2. The Free space hologram display panel of claim1, contains one or more different stacks of material having different optical properties and features, where in a Liquid Crystal Display (LCD) based or any type of Light Emitting Diode (LED) based or light based or Cathode Ray Tube (CRT) based display or Electronic paper based or Digital Paper based or pixelated based display or any type of pixelated based display or pixelated images & photos

based or pixelated video based or illuminated picture based or illuminated photo based free space “pop-out” & “sink-in” hologram display panel, the special features made with special material having special properties are built on top of the display. Display panel and the multi stacked structure contains one or more of the following: combined array of lenses and mirrors, array of prisms, array of lenses, array of mirrors, array of lenticules, array of lenticular lenses, array of convex lenses, array of concave lenses, array of diverging lenses, array of converging lenses, array of multi faced structures, array of multi faced lenses, array of multi faced mirrors, array of actuators, array of electromagnetic filters, array of colour filters, array of polarisers, optical spacer arrays or layers, array of optical filters, array of mirrors, array of optical total internal reflecting structures, array of hydrophilic areas, array of hydrophobic areas, array of both a combination of hydrophilic and hydrophobic areas, array of liquid lenses of various shapes and kinds, array of diverging optics, array of converging optics, array of lenticular optics, array of electromagnetic inductors and magnetic field inducer array where it's used to bend light selectively by means of magnetic fields created by an array of magnetic field generators placed on the surrounding area or under or on the surface or above the free space hologram display panel, where the bending of the light beams' path in free space as well as within, enabled the creation of the free space hologram.

The dimensions of each of the above listed can vary between a few nanometre to a few millimetre or a few centimetre or a few metres or a few kilometres.

3. The free space “pop-out” & “sink-in” hologram of claim 1, is seen or created on top of the flexible or rigid following displays: LCD or LED or OLED or AMOLED, TFT, CRT or illuminated photo or illuminated picture or similar display panel, but not limited to these display panel types, and can walkthrough, or put the hand through the free space “pop-out” & “sink-in” hologram. Further, the free space “pop-out” & “sink-in” hologram A few specific material layers with specific features and structures are placed on the display panel in order to guide light in such a manner to obtain the free space hologram on the display.

4. The free space hologram display panel of claim 1, is used with single or multiple mirrors in order to view multiple holograms along with the free space hologram. The mirrors are placed at various angles to the free space “pop-out” & “sink-in” hologram display screen, but still forming the free space “pop-out” & “sink-in” hologram in front of the mirror, so that the observer can touch through the free space hologram

5. The free space hologram display panel of claim 1, may contain liquid lenses or liquid lens arrays on the surface of the display screen in order to create the free space hologram. The liquid lenses are created by patterning hydrophilic and hydrophobic areas on the

surface of the display and applying the liquid onto this patterned surface, thereby creating lenses on the hydrophilic areas by self formation of liquid lenses on the hydrophilic areas.

6. The free space hologram display panel of claim 1, may contain liquid lenses or liquid lens arrays on the surface of the display screen in order to create the free space hologram, where the liquid lenses are created by patterning hydrophilic and hydrophobic areas on the surface of the display and applying the liquid onto this patterned surface, thereby creating lenses on the hydrophobic areas by self formation of liquid lenses on the hydrophobic areas or the liquid lenses are self-formed on the hydrophilic areas, when liquid is smeared over the surface which has patterned hydrophilic and hydrophobic areas.

7. The free space hologram display panel of claim 1, may contain, different optical patterns or material or structures on top of the display screen in multiple directional patterns in order to make full round free space “pop-out” & “sink-in” hologram where the observer can view the front, back, two sides’ views by walking around the free space hologram. For an example, the display screen may be divided into four triangular regions and the material used and the structural pattern in each region is specifically designed for that particular region.

8. The free space hologram display panel of claim 1, may contain, one or more of the array of structures or array of lenses or array of actuators or optical & electromagnetic/electrostatic components may be moved in order to optimise the performance and quality of the free space “pop-out” & “sink-in” hologram, by means of an electrostatic actuator or electromagnetic actuator.

9. The free space hologram display panel of claim 1, may be used as a foldable hologram display and can be used as a hologram book, foldable tablet, foldable monitor, foldable television, foldable phone, where when the display is folded it looks as if a closed book and when it is opened it can be a hologram generating book or a hologram generating tablet or hologram generating monitor or hologram generating television or hologram generating phone. Here, when the folded display is opened, the free space “pop-out” & “sink-in” hologram will pop out.

10. The free space hologram display panel of claim 1, may be used in such a manner that two or more hologram display screens may be joined together with hinges to create a foldable free space hologram display. This foldable hologram display can be used as a hologram book, foldable tablet, foldable monitor, foldable television, foldable phone, where when the display is folded it looks as if a closed book and when it is opened it can be a

hologram generating book or a hologram generating tablet or hologram generating monitor or hologram generating television or hologram generating phone. Here, when the folded display is opened, the free space “pop-out” & “sink-in” hologram will pop out.

11. The free space hologram display panel of claim 1, may be used for mobile phones, television, computer monitors and the display used in health care equipment such as x-ray machines, CAT scanners, MRI scanners, ultra sound scanners, endoscopes, endoscope capsules, to view the scanned images in free space “pop-out” & “sink-in” 3D hologram. when a fetal scan is performed on a pregnant mother in order to check the health of the fetus, the fetus is seen as a free space “pop-out” & “sink-in” hologram where the fetus can be seen above the free space “pop-out” & “sink-in” hologram display panel used with the scanner equipment and the physician can make a precise evaluation on the fetus, but not limited to fetus. By using a phone or a tablet or a suitable device equipped with the free space “pop-out” & “sink-in” hologram display panel, the parents of the fetus can do a “virtual cuddle” of the fetus by using the free space “pop-out” & “sink-in” hologram of the fetus.

12. The free space hologram display panel of claim 1, is connected to a device or component where specially processed video signal or still image is generated and delivered to the input of the hologram display. The device or the component may have wi-fi, Bluetooth, 2G, 3G, 4G, 5G or other communication means, GPS capability and other multiple digital and analogue functions and operations.

13. The free space hologram display panel of claim 1, is used to create various different multiple environments inside a aircraft cabin or inside the car cabin or inside the house or inside a space craft or inside a vehicle or inside a Gymnasium or inside a stadium or inside of a hotel room or surrounding an exercise machine creating virtual 3D environment such as a hologram jungle where the exercise machine is immersed in the free space “pop-out” & “sink-in” hologram, but not limited to these. The free space “pop-out” & “sink-in” hologram display screen can be made with a flexible screen or rigid screen. The flexible free space “pop-out” & “sink-in” hologram screen is used as a sticker or a wall paper on the inner walls or partitions of the aircraft cabin or in any other vehicle cabin or the building. For example, the aircraft passenger can bring his own preferred environment content saved or recorded into a digital or analogue memory such as a memory card, hard disk, thumb drive, etc. The free space “pop-out” & “sink-in” hologram device can be loaded with 3D models created with CAD software and these models can be used to generate free space “pop-out” & “sink-in” holograms. The user of the free space “pop-out” & “sink-in” hologram display device can create his own free space “pop-out” & “sink-in” hologram by making a drawing

with the software provided in the hologram device and then applying the necessary transforms and transformations to the drawings and then displaying the free space “pop-out” & “sink-in” hologram of the drawing on the free space “pop-out” & “sink-in” hologram display device. For example, but not limited to the following, the free space pop out and sink-in hologram is used to simulate and create an environment such as being in a jungle, seashore, or whatever the audience or passenger or occupier wish to have. The environment can be created in all areas and directions which the audience can see.

14. The free space hologram display panel of claim 1, is used for a smart wrist watch which has phone and wireless broad band functions. When receiving a phone call or communicating using this hologram smart watch, a free space hologram can be seen of the other caller. For example, it may be seen as if the other caller was standing or sitting on the smart hologram phone.

15. In free space hologram display panel of claim 1, the free space “pop-out” & “sink-in” hologram can be turned ON or turned OFF by means of a hardware 4-way switch or a 4-way soft switch whereby the display is toggled between 2D mode, 3D sink-in mode, 3D pop-out mode, free space “pop-out” & “sink-in” hologram mode and when operated in 2D mode, the display clarity is maintained in such a way that very fine text or features displayed on the display can be seen very clearly and much clearer than the iPhone 11 Pro max display or any other mobile display available at present. When the hologram display is operated in 2D, 3D or “pop-out” & “sink-in” hologram modes, the display clarity is maintained in such a way that very fine text displayed on the display can be seen very clearly. In 3D mode, free space “pop-out” & “sink-in” hologram mode and 2D mode, it can operate in full colour and in High definition (HD) or Ultra High Definition (UHD) or 4K or 8K or any other higher or lower resolution and not limited to these resolutions.

16. The free space hologram display panel of claim 1, is used in a mobile device for use in video conferencing such that individuals’ images are seen in free space holograms, above the free space hologram screen.

17. The free space hologram display panel of claim 1, is used as a GPS navigation tool so that users are able to clearly visualise the environment they will be heading to, and for entertainment such as gaming, watching videos and sports, just to name a few.

18. The free space hologram display panel of claim 1, is used in a television, allowing the viewer to watch any mundane television programme – such as sports or news – in breath-taking “pop-out” & “sink-in” holographic form. The television can be either placed vertically

or horizontally and can be rotated to make it to be in a landscape position or portrait position, thereby enabling viewing of the free space “pop-out” & “sink-in” hologram from multiple directions and multiple modes.

19. The free space hologram display panel of claim 1, is used in medical equipment such as X-ray images, Computerized Axial Tomography (CAT) scan images, Magnetic Resonance Imaging (MRI) scan images, images acquired by endoscopes, images acquired by endoscope capsules, in order for these images to be seen in holographic form and hence facilitates viewing and analysis by multiple personnel from 360° around the hologram.

20. The free space hologram display panel of claim 1, is used in educational tools such as an AR/VR training tool for professionals and students. This works by hovering the device with the “pop-out” & “sink-in” hologram display above a specific text or image to activate the AR/VR function on the device so that specific visuals of how a machine works, a science experiment is carried out or a visual representation of what a text is talking about may be seen in a holographic form to enhance learning. This use may prove especially functional in the medical industry where medical staff will be able to view entire systems in the human body in a “pop-out” & “sink-in” 3D holographic form, simply by hovering the device over their textbooks or notes, allowing them to more easily visualise what needs to be done in medical procedures such as surgeries.

21. The free space “pop-out” & “sink-in” hologram display panel of claim 1, is used in webinars, web based virtual meetings, virtual tours with free space “pop-out” & “sink-in” holograms for marketing, distant learning, e-learning, educational seminars, training seminars, business meetings, medical & collaboration meetings, tele medicine, virtual personnel assistants, voice assistants such as APPLE Inc.’s “Siri” voice assistant, Google Inc.’s Google Assistant, Amazon Inc.’s Alexa voice assistant, etc, but not limited to these, where it shows a person in free space “pop-out” & “sink-in” hologram over or on the mobile device or hologram device interactively talking with the user of the device, to make the experience with the virtual personnel assistant more realistic & such voice assistants, and many more uses and applications where the people & objects can be seen in free space “pop-out” & “sink-in” holograms as if the living person or objects are sitting or standing on the display screen, thereby creating a virtual real life like environment which brings the participants of virtual meetings to feel to be very much natural.

22. The free space hologram display panel of claim 1, is used in the fashion industry, where holographic images of various clothing items from hats and shoes to T-Shirts and dresses can be displayed to show the exact dimensions of the article of clothing, allowing

the buyer to visualise exactly how they would look when dressed in it, thus providing a virtual 'fit-on' experience where a photograph of the person can be captured with a camera and the persons photograph can be converted to a free space hologram and the clothing which needs to be checked out which is also in hologram form can be superimposed on the person's photograph in order to view how good or bad the particular clothing will look on the person.

23. The free space hologram display panel of claim 1, is used to form life size free space hologram of clothes where the free space hologram display screen is placed horizontally or flat on the floor and generating the hologram to be vertical and thereby enabling to do a virtual fit-on of clothes, where a person can walk into the hologram and check how the clothes in the hologram will look like on him.

24. The free space hologram display panel of claim 1, is used by dress designers to design dresses so that special dresses can be done a virtual try-on before even sewing the dresses, similarly engineers can use live size free space holograms to check their designs of cars, engines, buildings, machines, equipment, consumer items, industrial goods, to list a few but not limited to these.

25. The free space hologram display panel of claim 1, is used to watch movies in free space hologram by having a large size free space hologram screen placed horizontally on the floor and generating the movie in hologram to be vertical, where the audience walk into the movie, creating the walk-through movie experience.

26. The free space hologram display panel of claim 1, is used to realize the free space "pop-out" & "sink-in" hologram Augmented Reality (AR) device or a free space "pop-out" & "sink-in" hologram Virtual Reality (VR) device or a free space "pop-out" & "sink-in" hologram Mixed Reality (MR) device by building or attaching a free space "pop-out" & "sink-in" hologram enabling screen on top of the Augmented Reality (AR), VR, MR device or AR, VR, MR hardware, or including any other free space "pop-out" & "sink-in" hologram enabled 3D screen onto the AR, VR or MR device, where the "pop-out" & "sink-in" hologram screen or 3D enabling screen is not limited to LCD based or Light Emitting Diode based or electronic paper based but is only is built-on²⁰ or attached on top of the existing regular display screen.

27. The free space "pop-out" & "sink-in" hologram AR, VR or MR device of claim 26, has the multimedia content artificially introduced into the image or live video by the camera of the AR, VR or MR device and is processed in such a way that the artificially introduced

content be viewed to be as if to be coming out of the “pop-out” & “sink-in” hologram 3D display screen or the content to be sink inside the display screen or part to be inside and part to be outside, where the 3D AR, 3D VR and 3D MR is done by combining both 3D optical hardware and processed multimedia content, and the “pop-out” & “sink-in” 3D hologram viewing may be done by means of using special eye ware or glasses or without using special eye ware or glasses.

28. The free space hologram display panel used in the free space “pop-out” & “sink-in” hologram AR, VR, MR device of claim 26, can be either an active “pop-out” & “sink-in” 3D hologram display when electric power is used or passive “pop-out” & “sink-in” 3D hologram display where electric power is not used.

29. The free space “pop-out” & “sink-in” hologram AR, VR, MR devices of claim 26, is used in training manuals, text books, instruction manuals for viewing details, for example when the camera of the AR device focus onto a particular text, symbol, photo, barcode, which represent an aircraft engine, the AR device will display an aircraft engine in free space “pop-out” & “sink-in” hologram enabling viewing it or viewing it in operation via video or simulation or providing the opportunity to the AR device user to operate the simulated dismantling or assembly of the engine and making it all possible to visualize everything in free space “pop-out” & “sink-in” 3D holographic space. Similarly, flight simulators for training pilots, training of physicians and engineers, planning of surgeries by physicians, use in spaceships for communication and entertainment are a few other applications, viewing street views, maps, world maps, satellite imaging, birds’ views, holographic perspectives and further, the AR device can be used for simultaneous viewing of “pop out” or “sink in” free space “pop-out” & “sink-in” hologram Augmented reality (AR) and Virtual reality (VR) and mixed reality (MR) by multiple people, with a single device, but not limited to these uses and applications where the free space “pop-out” & “sink-in” hologram is used with free space “pop-out” & “sink-in” hologram Augmented Reality (AR), free space “pop-out” & “sink-in” hologram Virtual Reality (VR) and free space “pop-out” & “sink-in” hologram mixed Reality (MR) functions, which is incorporated with gesture recognition where the observer can make a certain gesture or for example, point his finger to one direction to rotate an object present in the AR, VR or MR to a certain direction. The gestures are not limited to pointing of a finger but can be used with a device which can be attached to the arm so that the arm movement can be detected and transmitted to the free space “pop-out” & “sink-in” hologram device which is used for free space “pop-out” & “sink-in” hologram manipulation. The gestures are not limited to pointing of a finger but can be used with unlimited number of various gestures.

30. The free space “pop-out” & “sink-in” hologram device of claim 1, is manipulated by means of using and incorporating brain wave detection and command technology or electroencephalography and audio recognition. The brain waves which relate to the particular manipulation of the free space “pop-out” & “sink-in” hologram is detected using electrodes or a headset attached to the head or other relevant body part of the living person/animal and then the detected brain wave is analysed and is transformed and a relevant command is transmitted to the free space “pop-out” & “sink-in” hologram device via a wireless transmission method and then, upon receiving of the command by the free space “pop-out” & “sink-in” hologram device, the relevant intended change in the hologram such as operate/manipulate/turn/rotate the X-rays, CAT scans or MRI scans or access any other information on the free space “pop-out” & “sink-in” hologram device is done. Brain wave detection and command technology is useful for this device since for example, during a surgery the surgeons will be able to operate/manipulate/turn/rotate the X-rays, CAT scans or MRI scans or access any other information on the free space “pop-out” & “sink-in” hologram device, by using surgeon’s brain wave detection, without requiring them to use hands or voice. Furthermore, the free space “pop-out” & “sink-in” hologram device can send information to the surgeon via the brain wave detection and command technology, through the electrodes attached to the head of the person with the aid of the headset. Similarly, signals from different body parts can be used to manipulate the “pop-out” & “sink-in” hologram device, but not limited to these signals. Similarly, the “pop-out” & “sink-in” hologram device can send signals directly to the users brain via the wireless enabled brain wave headset, to stimulate and communicate with the brain.

31. The free space “pop-out” & “sink-in” hologram display device of claim 1, is used in association with a reflective plate or reflective surface or a reflective mirror which is placed at an angle to the free space “pop-out” & “sink-in” display panel, there by enhancing or multiplying the free space “pop-out” & “sink-in” holograms which are displayed on top of free space “pop-out” & “sink-in” hologram display panel.

32. A multimedia device or an image/video capture and display device having the free space hologram display of claim 1, enables the “pop-out” & “sink-in” free space “pop-out” & “sink-in” hologram pop-out & sink-in 3D effects on Augmented reality and virtual reality devices, when used in combination with the following:

A camera having a human eye like camera lens for capturing 3D hologram capable images, where the camera lens which mimics the human eye by changing it’s lens aperture according to the light intensity, similar to the pupil of the human eye and focus & capture 3D images suitable for free space “pop-out” & “sink-in” hologram.

A software to operate the multimedia device.

A software to generate the pop-out & sink-in 3D effects.

A visual display capable of generating a pop-out & sink-in 3D effect, when viewed by the user of the 3D AR device.

An artificially insert new objects into the live image captured by the camera of the imaging device, where the new object and the live image are both displayed in pop-out & sink-in 3D.

Ability to insert new video into the live image captured by the camera of the imaging device, where the new video and the live image are both displayed in pop-out & sink-in 3D holgram.

A regular visual display converted to a pop-out & sink-in 3D hologram capable visual display by building or placing a special optical device on top of the regular visual display screen and there by enabling glasses free 3D viewing.

A regular visual display converted to a pop-out & sink-in 3D capable visual display by building or placing a special optical screen on top of the regular visual display screen and there by enabling glasses free 3D hologram viewing.

A regular visual display converted to a pop-out & sink-in 3D hologram capable visual display by building or placing a special optical filter on top of the regular visual display screen and there by enabling glasses free 3D hologram viewing.

A regular display being converted to 3D display by means of using polarizing material on top of the regular visual display screen and using eye glasses to view the pop-out & sink-in 3D images on the visual display screen.

The images captured by the camera are converted to pop-out & sink-in 3D friendly 3D hologram capable images where when these images are displaced in a 3D hologram visual display, it can be viewed as pop-out & sink-in 3-Dimentional images just as humans see real world objects in 3dimentional space. The images of objects superimposed onto the images captured by the camera are also converted to 3D friendly pop-out & sink-in 3D capable images.

The conversion of the normal image to "pop-out" & "sink-in" capable image is done by special software algorithms used with the 3D AR device.

Ability to set the settings so that depending on settings selected by the user, the depth where the object is placed can be adjusted so that the object can be either

viewed as if it comes out or pops out from the visual display screen or sink into the screen.

By pointing the camera to a photo or an object, the AR or VR device will start playing a pop-out or sink-in 3D hologram video on the Augmented reality (AR) device's screen.

By pointing the camera to a photo or an object, the AR or VR device will start playing a pop-out or sink-in 3D hologram video on the Virtual reality (VR) device's screen.

A geographic Positioning system devices known as GPS devices can display maps in pop-out & sink-in hologram.

33. Camera of the free space "pop-out" & "sink-in" hologram device of claim 1, which is capable of capturing "pop-out" & "sink-in" hologram quality fully focussed images and videos has a lens module which consists of juxtaposed rings of photochromic or thermochromic or magnetochromic or electrochromic material which are painted or fabricated on the lens. Photochromic material changes its opacity with the change of light intensity and thermochromic material changes its opacity with the change of temperature and magnetochromic material changes its opacity with the change of magnetic field and electrochromic material changes its opacity with the change of electric field. When photochromic material is used for the juxtaposed rings and when the light intensity is lower than a pre-determined value, all the rings are transparent and the aperture of the lens is at its maximum. When the light intensity increases the painted photochromatic rings become opaque. The rings can be selectively turned to be opaque in such a manner that the rings towards the outer edge first become opaque and extends towards the rings which are more towards the middle of the lens, when the light intensity gradually increase thereby making the aperture smaller gradually, mimicking the pupil of the human eye. Similarly as described above, depending on the material used for the rings, the thermochromic rings, magnetochromic rings or electrochromic rings can be made opaque by applying heat, a magnetic field, an electric field respectively. The photochromic Juxtaposed rings can be made to be opaque by the light coming from the field of view and its surroundings and which is incident on the rings, thereby forming a self sufficient smart aperture. The thermochromic or magnetochromic or electrochromic based aperture rings will have to be controlled by using external or internal respective stimulants such as heat, magnetic field, electric field with the utilization of feedback techniques to determine the quantity of the stimulant to be applied. In order to activate the thermochromic or magnetochromic or electrochromic based aperture rings, it require providing electricity to the activator of the rings and therefore optically transparent electrodes placed on the lens are used as the

electric conductors. By using combinations of these variable aperture/variable focus lenses, very high quality cameras are made which can capture images with very high image quality and image details which can easily capture “pop-out” & “sink-in” hologram capable images and videos, where all objects in it’s field of view are in focus.

34. Camera capable of capturing hologram quality fully focussed images and videos with the free space “pop-out” & “sink-in” hologram display device of claim 1, has a camera lens which consists of Juxtaposed rings, which forms a variable focus zone plate lens or a variable focus Fresnel zone lens for focusing of images in a photographic camera, by making alternate rings opaque and transparent by means of the appropriate stimulant such as light, heat, magnetic field or electric field, where These optical lenses in conjunction with other optical lenses are used to make a hologram camera with hologram zoom, by having multiple arms attached onto the camera, which provides or supply parts of the final image which is formed on the image sensor of the camera, where by using only one image sensor, multiple images from multiple viewpoints are captured simultaneously by using an optical system where it uses multiple prisms or mirrors to get total internal reflection of light or reflection of light respectively, in order to turn, guide and transmit the light from two directions on to a single image sensor, through a combination of lenses, apertures and zone plates, thereby producing Side-by-Side or Up-Down or Side-by-Side-Up-Down images or videos recorded by this camera.

35. Camera capable of capturing “pop-out” & “sink-in” hologram quality fully focussed images and videos with the multimedia device or image/video capture and display device of claim 1, has a camera lens which consists of juxtaposed rings, which forms a variable focus zone plate lens or a variable focus Fresnel zone lens for focusing of images in a photographic camera, by making alternate rings opaque and transparent by means of the appropriate stimulant such as light, heat, magnetic field or electric field. These rings can either be concentric or acentric rings. These rings can also be operated in such a way that a few of adjacent rings can be made to be transparent while the next few rings can be made to be opaque in a repetitive manner by applying the appropriate stimulant to the rings selectively, depending on the material used for the rings, in order to make it operate as a compound lens with the lens on which the rings are painted, printed or fabricated. These Juxtaposed rings which can be selectively made transparent or opaque by means of applying a stimulant is used to make Binary zone plate where the surface areas are equal for each and every transparent and opaque ring where these rings alternate between opaque and transparent. Similarly, a Sinusoidal zone plate is made by making the width of each opaque and transparent ring equal. A series of lenses or a lens system formed by a collection of above mentioned compound lenses is used to form zoom lens or a stack of suitably spaced above

described zone plates or the stack of suitably spaced above described zone plates combined with regular lenses are used to form zoom lenses. By using combinations of these variable aperture/variable focus/variable zoom lenses described above, very high quality camera is made which can capture images with very high image quality and image details which can easily capture “pop-out” & “sink-in” hologram capable images and videos, where all objects in it’s field of view are in focus where these cameras can be used on mobile devices, clinical diagnostic equipment, engineering applications, space applications such as in satellites & space vehicles, web cams, surveillance & security cameras, body cameras, wearable cameras, car cameras, car dash cameras, endoscopes and endoscopic capsule camera.

36. The free space “pop-out” & “sink-in” hologram device of claim 1, consists of video and still image processing technologies and algorithms which incorporates image and video processing using one or more of the methods and processes such as translation, transforms, transformations, sine transformation, cosine transformation, tan transformation, inverse sin cosine tan transformations, rotary transformations, fourier transform, double split transforms

37. Free space “pop-out” & “sink-in” hologram device of claim 1, uses spatial audio, which enhance the free space “pop-out” & “sink-in” hologram experience by simulating real life auditory effects. This audio provides multi-dimensional multi-directional audio effects. The effect is obtained by controlling the audio parameters such as but not limited to amplitude, frequency, treble, etc. Here, for example, to simulate a vehicle moving from left side to the right side by means of spatial audio, the amplitude of the sound of the vehicle is gradually increased on the left side headphone while for right side headphone the amplitude of the sound increased at a much lower amount or rate, until both amplitudes become equal when the vehicle is at the front of the observer or the middle of the display screen. Subsequently, when the vehicle continue to travel to the right side of the screen or passing the observer, the amplitude at the left side speaker or headphone is gradually decreased while the amplitude of the right side speaker or headphone is gradually reduced to zero. Similarly, frequency is adjusted to incorporate the well known Doppler effect which enhances the natural feeling of the audio regeneration. The frequency is gradually increased when the vehicle is moving towards the observer or the middle of the screen, until the vehicle comes to the front or middle of the screen and gradually decreased when the vehicle is moving away from the observer or the center of the screen.

38. The free space “pop-out” & “sink-in” hologram display device of claim 1, is used to project two or more different movies or pictures in free space “pop-out” & “sink-in” hologram simultaneously, which can be watched by two or more viewers, where each

viewer can watch one movie at a given time, without having any interference from the other free space “pop-out” & “sink-in” hologram movie or photo.

39. In the free space “pop-out” & “sink-in” hologram display device of claim 1, multiple cameras are used to create multi side-by-side (SBS) multi view free space “pop-out” & “sink-in” holograms and is used for capturing the front view, back view, side views, top view and bottom view and these views are fed into the display panel’s predetermined, multiple specific areas to generate the 360 degree free space “pop-out” & “sink-in” hologram.