(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
24 September 2015 (24.09.2015)

WIPO | PCT

(10) International Publication Number
WO 2015/140815 A1

(51) International Patent Classification:
*G06T 19/00* (2011.01) *H04N 5/66* (2006.01)
*G06T 1/00* (2006.01)

(21) International Application Number:
PCT/IN2015/000129

(22) International Filing Date:
16 March 2015 (16.03.2015)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
426/DEL/2014 15 March 2014 (15.03.2014) IN

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

**Declarations under Rule 4.17**:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

*[Continued on next page]*

# (54) Title: REAL-TIME CUSTOMIZATION OF A 3D MODEL REPRESENTING A REAL PRODUCT

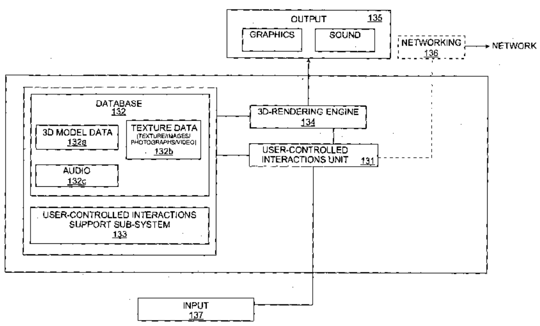


FIG. 17 (a)

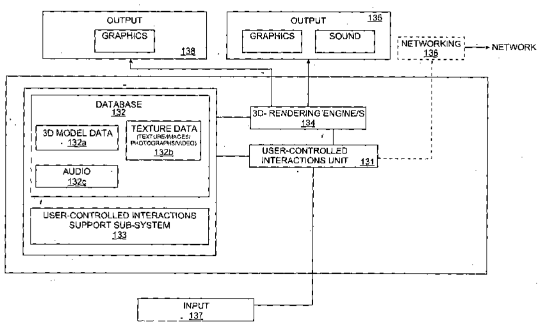


FIG. 17 (b)

**(57) Abstract**: A computer implemented method for visualization of a 3D model of an object, wherein the method includes: - generating and displaying a first view of the 3D-model; - receiving an user input, the user input are one or more interaction commands comprises interactions for customization of 3D model by at least one of adding, removing, replacing, scaling, or changing geometry, or combination thereof, of mechanical, electronic, digital, or pneumatic part/s of the 3D model by changing texture and/or graphics data of the part - identifying one or more interaction commands; -in response to the identified command/s, rendering of corresponding interaction to 3D model of object with or without sound output using texture data, computer graphics data and selectively using sound data of the 3D- model of object; and - displaying the corresponding interaction to 3D- model.

WO 2015/140815 A1

— *of inventorship (Rule 4.17(iv))*

**Published**:

— *with international search report (Art. 21(3))*

# REAL-TIME CUSTOMIZATION OF A 3D MODEL REPRESENTING A REAL PRODUCT

## FIELD OF INVENTION

The invention relates to visualizing a 3D model. More specifically, the invention relates to visualizing and interacting with the 3D model.

## BACKGROUND OF THE INVENTION

There is an increasing trend to display the real products digitally with the help of images, videos and/or animations. However, there exists a difficulty for users to know about variations or customization options available with a manufacturer for a particular version of real object such as a model of car and a lot of time and effort is required to gain such information. Further, even if users become aware of customization possibilities for a product, it becomes challenging to visualize and know, how the customization will look like, before making any buying decision or before modifying an existing product. Even in real situation, when users visit a physical establishment, all customized options are rarely available for visualization. Again, if a user wants to further modify a real object such as automotive vehicle like bike or car as per his taste, such customization possibilities in a system in real-time with a real looking 3D model representing a real object, for realistic visualization and user-controlled interaction with the 3D model, where further interaction with the modified or customized model can be performed is a challenging task and lacking in existing systems.

In some implementation, such as websites/systems offering car customization such as 3Dtuning.com, ford.com are built in Adobe® Flash® using images and show product in 2D graphics environment. However, clear interior view of the product is not available for customization and visualization, and further performing any kind of interaction with the replaced part is challenging. User-controlled realistic interaction such as viewing softness property of replaced seats, rotations in 360 degree in all planes, moving or adjusting replaced parts such as seats with the customized part or car, is lacking.

The object of the invention is to provide an easy to use solution for carrying out real-time customization of objects using a realistic 3D model of the real object.

SUMMARY OF THE INVENTION

The object of the invention is achieved by method of claim 1, system of claim 29 and a computer program product of claim 30.

According to one embodiment of the method, the method includes:

- generating and displaying a first view of the 3D-model;
- receiving an user input, the user input are one or more interaction commands comprises interactions for customization of 3D model by atleast one of adding, removing, replacing, scaling, or changing geometry, or combination thereof, of mechanical, electronic, digital, or pneumatic part/s of the 3D model by changing texture and/or graphics data of the part

- identifying one or more interaction commands;
-in response to the identified command/s, rendering of corresponding interaction to 3D model of object with or without sound output using texture data, computer graphics data and selectively using sound data of the 3D- model of object; and
- displaying the corresponding interaction to 3D- model.

According to another embodiment of the method, wherein customization by adding comprises adding one or more new part/s to the 3D model at a predefined appropriate position.

According to yet another embodiment of the method, wherein customization by replacing and/or removing is performed on a predefined part/s.

According to one embodiment of the method, wherein customization by scaling is performed on a predefined part and/or to a predefined limit.

According to another embodiment of the method, wherein the part of 3D model can be customized by shape in particular geometry of predefined options.

According to yet another embodiment of the method, wherein the 3D- model after customization is adapted to behave as an entity, in the same way as the 3D model was behaving before customization, so as the 3D model after customization is viewable from all angles.

According to one embodiment of the method, wherein the customization is adapted to be performed in any angular orientation of the 3D model.

According to another embodiment of the method, wherein the interaction command comprises extrusive interaction and/or intrusive interactions and/or a time bound change based interaction and/or a real environment mapping based interaction and combination thereof, as per user choice and/ or as per characteristics, state and nature of the said object, wherein the time bound changes refers to representation of changes in 3D model demonstrating change in physical property of object in a span of time on using or operating of the object, and real environment mapping refers to capturing a real time environment, mapping and simulating the real time environment to create a simulated environment for interacting with the 3D model.

According to yet another embodiment of the method, wherein the interaction commands are adapted to be received before customization and/or during customization and/or after customization.

According to one embodiment of the method, wherein the extrusive interaction comprises atleast one of:
- interacting with a 3D model representing an object having a display for experiencing functionality of Virtual GUI on virtual display of displayed 3D model; to produce the similar changes in corresponding GUI of 3D model as in GUI of the object for similar input;
- interacting for operating and/or removing movable parts of the 3D model of the object, wherein operating the

movable parts comprises sliding, turning, angularly moving, opening, closing, folding, and inflating-deflating the parts

- interacting with 3D model of object for rotating the 3D model in 360 degree in different planes;
- operating the light-emitting parts of 3D-model of object for experiencing functioning of the light emitting part/s, the functioning of the light emitting part/s comprises glowing or emission of the light from light emitting part/s in 3D-model in similar pattern that of light emitting part/s of the object;
- interacting with 3D-model of object having representation of electronic display part/s of the object to display response in electronic display part of 3D- model similar to the response to be viewed in electronic display part/s of the object upon similar interaction;
- interacting with 3D-model of object having representation of electrical/electronic control of the object to display response in the 3D-model similar to the response to be viewed in the object upon similar interaction;
- interacting with 3D- model for producing sound effects;

or

combination thereof.

According to another embodiment of the method, wherein functioning of light emitting part is shown by a video as texture on surface of said light emitting part to represent lighting as dynamic texture change.

According to yet another embodiment of the method, the intrusive interactions comprises atleast one of:

- interacting with sub-parts of the 3D- model of the object, wherein sub-parts are those parts of the 3D-model which are moved and/ or slided and/or rotated and/or operated for using the object;
- interacting with internal parts of the 3D model, wherein the internal parts of the 3D -model represent parts of the object which are responsible for working of object but not required to be interacted for using the object, wherein interacting with internal parts comprising removing and/or disintegrating and-/or operating and/or rotating of the internal parts;
- interacting for receiving an un-interrupted view of the interior of the 3D model of the object and/ or the sub-parts;
- interacting with part/s of the 3D model for visualizing the part by dismantling the part from the entire object;
- interacting for creating transparency-opacity effect for converting the internal part to be viewed as opaque and remaining 3D model as transparent or nearly transparent;
- disintegrating different parts of the object in exploded view; or

combination thereof.

According to yet another embodiment of the method, wherein the real environment mapping based interactions comprises atleast one of:

- capturing an area in vicinity of the user, mapping and simulating the video/ image of area of vicinity on a surface of 3D model to provide a mirror effect;
- capturing an area in vicinity of the user, mapping and simulating the video/ image of area of vicinity on a 3D space where 3D model is placed; or

combination thereof.

According to one embodiment of the method, wherein the interaction comprises liquid and fumes flow based interaction for visualizing liquid and fumes flow in the 3D model with real-like texture in real-time.

According to another embodiment of the method, wherein the interaction comprises immersive interactions, the immersive interactions are defined as interactions where users visualize their own body performing user-controlled interactions with the virtual computer model.

According to yet another embodiment of the method, wherein displaying of new interaction/s to the 3D-model while previously one or more interaction has been performed or another interaction/s is being performed on the 3-D model.

According to one embodiment of the method, wherein rendering of corresponding interaction to 3D model of object in a way for displaying in a display system made of one or more electronic visual display or projection based display or combination thereof.

According to another embodiment of the method, wherein the display system is a wearable display or a non-wearable display or combination thereof.

According to yet another embodiment of the method, wherein the non-wearable display comprises electronic visual displays such as LCD, LED, Plasma, OLED, video wall, box shaped display or display made of more than one electronic visual display or projector based or combination thereof.

According to one embodiment of the method, wherein the non-wearable display comprises a pepper's ghost based display with one or more faces made up of transparent inclined foil/screen illuminated by projector/s and/or electronic display/s wherein projector and/or electronic display showing different image of same virtual object rendered with different camera angle at different faces of pepper's ghost based display giving an illusion of a virtual object placed at one places whose different sides are viewable through different face of display based on pepper's ghost technology.

According to another embodiment of the method, wherein the wearable display comprises head mounted display, the head mount display comprises either one or two small displays with lenses and semi-transparent mirrors embedded in a helmet, eyeglasses or visor. The display units are miniaturised and may include CRT, LCDs, Liquid crystal on silicon (LCos), or OLED or multiple micro-displays to increase total resolution and field of view.

According to yet another embodiment of the method, wherein the head mounted display comprises a see through head mount display or optical head-mounted display with one or two display for one or both eyes which further comprises curved mirror based display or waveguide based display.

According to one embodiment of the method, wherein the head mounted display comprises video see through head mount display or immersive head mount display for fully 3D viewing of the 3D-model by feeding rendering of same view with two slightly different perspective to make a complete 3D viewing of the 3D- model.

According to another embodiment of the method, wherein the 3D model moves relative to movement of a wearer of the head-mount display in such a way to give to give an illusion of 3D model to be intact at one place while other sides of 3D model are available to be viewed and interacted by the wearer of head mount display by moving around intact 3D model.

According to yet another embodiment of the method, wherein the display system comprises a volumetric display to display the 3D model and interaction in three physical dimensions space, create 3-D imagery via the emission, scattering, beam splitter or through illumination from well-defined regions in three dimensional space, the volumetric 3-D displays are either auto stereoscopic or auto multiscopic to create 3-D imagery visible to an unaided eye, the volumetric display further comprises holographic and highly multiview displays displaying the 3D model by projecting a three-dimensional light field within a volume.

According to one embodiment of the method, wherein the display system comprises more than one electronic display/projection based display joined together at an angle to make an illusion of showing the 3D model inside the display system, wherein the 3D model is parted off in one or more parts, thereafter parts are skew in shape of respective display and displaying the skew parts in different displays to give an illusion of 3d model being inside display system.

According to another embodiment of the method, wherein the input command is received from one or more of a pointing device such as mouse; a keyboard; a gesture guided input or eye movement or voice command captured by a sensor , an infrared-based sensor; a touch input; input received by changing the positioning/orientation of accelerometer and/or gyroscope and/or magnetometer attached with wearable display or with mobile devices or with moving display; or a command to a virtual assistant.

According to yet another embodiment of the method, wherein command to the said virtual assistant system is a voice command or text or gesture based command, wherein virtual assistant system comprises a natural language processing component for processing of user input in form of words or sentences and artificial intelligence unit using static/dynamic answer set database to generate output in voice/text based response and/or interaction in 3D model.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1(a) to FIG. 1(c) illustrates an example of the invention where wheels of virtual car are customized.

FIG. 2(a) to FIG.2(c) illustrates an example of the invention where seat of virtual car is customized with a sofa.

FIG. 3(a) to 3(f) illustrates an example of the invention where handle of a virtual motorcycle is customized and performing functionality on the customized handle.

FIG. 4(a) to FIG. 4(f) illustrates an example of the invention where headrest of virtual bed is customized along with changing geometry of the customized headrest.

FIG. 5(a) to FIG. 5(c) illustrates an example of the invention where bulb of virtual lamp is replaced along with change in illumination pattern of the replaced bulb.

FIG. 6(a) to FIG. 6(c) illustrates an example of the invention where a control panel of virtual table fan is replaced while keeping the fan on.

FIG. 7(a) to FIG. 7(d) illustrates an example of the invention where a wrist band of a watch is replaced.

FIG. 8(a) to FIG. 8(e) illustrates an example of the invention where a virtual ring 804 is customized and scaled.

FIG 9(a) to FIG 9(e) illustrates an example of the invention where a man wearing a see-through head mount display (HMD) and customizing a motorcycle.

FIG 10(a) to FIG 10(e) illustrates an example of the invention where a man wearing an immersive head mount display (HMD) and customizing a motorcycle.

FIG 11(a) and FIG 11(b) illustrates an example of the invention where a 3D model is displayed on a video wall.

FIG 12(a) to FIG 12(e) illustrates an example of the invention where a man wearing a see-through head mount display (HMD) and customizing and interacting with a virtual refrigerator.

FIG 13(a) to FIG 13(e) illustrates an example of the invention where a man wearing an immersive head mount display (HMD) and customizing and interacting with a virtual refrigerator.

FIG 14(a)- FIG 14(d) illustrates an example of the invention where the 3D model is shown and interacted on a cube based display.

FIG 15(a)- FIG 15(c) illustrates an example of the invention where the 3D model is shown and interacted on a holographic display.

FIG 16 illustrates a block diagram of the system implementing the invention.

FIG 17(a)- FIG 17(b) illustrates a block diagram of another embodiment of the system implementing the invention.

FIG. 1(a) to FIG. 1(c) illustrates an example of the invention where wheels of virtual car 101 are customized. Figure 1(a) shows a virtual car 101 placed in a particular orientation 102 with front wheel 104 of the car 101. Also, various options of wheel 106, 107, 108 are shown. User selects wheel 105 from the options in FIG 1(b) and replaces the front wheel 104. In FIG 1(c), the virtual car 101 is interacted to change orientation of car from 102 to 103. The virtual car 101 can be both in 2D or 3D and the customization of the wheel requires change in texture and graphics of the front wheel of the virtual car 101. The virtual car 101 can be interacted to be rotated in 360 degrees.

FIG. 2(a) to FIG.2(c) illustrates an example of the invention where seat 202 of virtual car 201 is customized with another seat 203, 204, 205. FIG. 2(a) shows the virtual car 201 having a back seat 202, Also, some customization option for back seat 202 with another seat 203, 204, 205 are shown. A user opens back gate of the virtual car and selects seat 204 as an option for replacing the back seat 202 in FIG. 2(b). In FIG 2(c) a front gate, as well as back gate are removed from the virtual car 201 to have a better view of interior of the virtual car 201.

FIG. 3(a) to 3(f) illustrates an example of the invention where handle 304 of a virtual motorcycle 303 is customized and performing functionality on the customized handle. In FIG. 3(a), the virtual motorcycle 303 is shown in an orientation 301 having handle 304. Also, shown are options 305, 306, 307 to customize the handle 304. In FIG 3(b), a user rotates the virtual motorcycle 303 to a different orientation 302. The virtual motorcycle 303 can be rotated 360 degrees in any orientation. Also, the user selects option 306 for changing the handle of the virtual motorcycle 303. In FIG 3(c), part 308 of the handle 306 is shown enlarged and the user operates back light by switching on the back light using switch 309 shown in the enlarged part 308 of the handle 306. In FIG 3 (d) shows switching on of the back light 312. In FIG 3(e) shows options 310, 311 for back support to be added as an accessory to the virtual motorcycle. User selects option 310 for back support and same is added at an appropriate place on the virtual motorcycle 303. In FIG 3(f) shows switching on of lights 313 of the back support after the customization.

FIG. 4(a) to FIG. 4(f) illustrates an example of the invention where headrest 404 of virtual bed 403 is customized along with changing geometry of the customized headrest. In FIG 4(a), the virtual bed 403 is shown with headrest 404 placed in an orientation 401. Also shown are the options 405, 406, 407 for change in current headrest 404. User selects option 406 for changing the headrest and the changed headrest 406 is shown in FIG 4(b). In FIG 4(c), the user rotates the virtual bed 403 to a different orientation 402. The virtual bed 403 can be rotated 360 degrees in any orientation. FIG 4(d) shows various options 408, 409, 410 to customize geometry of the headrest 406. User selects the option 408 to change the geometry of the headrest 406. The changed headrest 409 is shown in the FIG 4(e). In FIG 4(f), the user rotates the virtual bed 403 to a different orientation 402 after customizing the geometry of the headrest.

FIG. 5(a) to FIG. 5(c) illustrates an example of the invention where bulb of virtual lamp 504 is replaced along with change in illumination pattern of the replaced bulb.

In FIG. 5(a), the virtual lamp 504 is shown along with various options 505, 506, 507 to replace bulb 505 of the virtual lamp 504. Currently, the bulb 505 is off and the environment is not illuminated 501. In FIG 5(b), the bulb 505 is switched on and the environment is illuminated with a particular illumination pattern 502. In FIG 5(c), the bulb 505 is replaced with option 506, in a switched on position, such that illumination pattern is changed from previous illumination pattern 502 to new illumination pattern 503.

FIG. 6(a) to FIG. 6(c) illustrates an example of the invention where a control panel 602 of virtual table fan 601 is replaced while keeping the fan on. In FIG 6(a), the virtual fan 601 is shown with control panel 602 and feathers 603, wherein the virtual fan 601 is switched off and the feathers 603 are still. In FIG 6(b), user switches on the virtual fan 601 by pressing switch 604 on control panel 602. In both FIG 6(a) and FIG. 6(b), options 605, 606, 607 for changing the control panel 602 are shown. User selects the option 607 to replace the control panel, while the fan is switched on. On customization, the control panel 607 is seen with switch 608 of the control panel 607 as being switched on. During the customization process of the control panel, the virtual fan 601 is not switched off and the feather 603 can be seen rotating while replacing the control panel.

FIG. 7(a) to FIG. 7(d) illustrates an example of the invention where a wrist band 705 of a virtual watch 704 is replaced. The virtual watch 705 is shown in one orientation 701 in FIG 7(a). Also shown are options 706, 707, 708 to customize the wrist band 705. In FIG 7(b) user selects option 707 to replace the wrist band 705. User rotates the wrist watch 704 after customization in different planes to be in orientation 702 and 703, as shown in FIG 7(c) and FIG 7(d) respectively.

FIG 8(a) to FIG 8(e) illustrates an example of the invention where a virtual ring 804 is customized and scaled. In FIG 8(a), the virtual ring 804 is shown along with its crown 805 placed in an orientation 801. Also shown are various options 805, 806, 807 to customize the crown of the virtual ring 804. Use replaces the crown 805 with option 806, as shown in FIG 8(b). User scales the virtual ring 804 along with the new crown 806, as shown in FIG 8(c). Further user changes orientation 802, 803 of the virtual ring 804 in FIG 8(d) and FIG 8(e) respectively after scaling up. With the change in orientation 801 to 802, the location of crown changes from 808 in FIG 8(c) to 809 in FIG 8(d), and change in orientation from 802 to 803, the location of crown changes from 809 in FIG 8(d) to 810 in FIG 8(e).

FIG 9(a) to FIG 9(e) illustrates an example of the invention where a man wearing a see-through head mount display (HMD) 906 and customizing a motorcycle 901. In FIG 9(a), the man wears the see-through HMD 906 and moves at different locations 902, 903, 904, 905, and when the man moves the motorcycle 901 seems to be intact at one position. The man sees different parts of the virtual motorcycle 901, while moving to different locations 902, 903, 904, 905. In FIG 9(b), the man moves to a first location 903, where the virtual motorcycle 901 remains intact at same position. In FIG 9(c), at a second location 904, the man switches on headlight 907 of the virtual motorcycle 901 by pressing a button placed at handle 908 through gesture 910. However, the virtual motorcycle 901 remains intact at same position. In FIG 9(d), the man moves to a third location 902, while the virtual motorcycle 901 remains intact at same position, and the man replaces the handle 908 with another handle 909 through gesture 911. In FIG 9(e), the man moves to a fourth location 905, while the virtual motorcycle 901 remains intact at same position, and the man add a bag 913 at an appropriate place in the virtual motorcycle 901 from options 913, 914, 915 through gesture 912.

FIG 10(a) to FIG 10(e) illustrates an example of the invention where a man wearing an immersive head mount display (HMD) 1001 and customizing a motorcycle 1006. In FIG 10(a), the man wears the immersive HMD 1001 and moves at different locations 1002, 1003, 1004, 1005, and when the man moves the motorcycle 1006 seems to be intact at one position. The man sees different parts of the virtual motorcycle 1006, while moving to different locations 1002, 1003, 1004, 1005. In FIG 10(b), the man moves to a first location 1002, where the virtual motorcycle 1006 remains intact at same position. In FIG 10(c), at a second location 1003, the man switches on headlight 1007 of the virtual motorcycle 1006 by pressing a button placed at handle 1008 through gesture 1013. However, the virtual motorcycle 1006 remains intact at same position. In FIG 10(d), the man moves to a third location 1004, while the virtual motorcycle 1006 remains intact at same position, and the man replaces the handle 1008 with another handle 1009 through gesture 1014. In FIG 10(e), the man moves to a fourth location 1005, while the virtual motorcycle 1006 remains intact at same position, and the man add a bag 1010 at an appropriate place in the virtual motorcycle 1006 from options 1010, 1011, 1012 through gesture 1015.

FIG 11(a) illustrates an example of the invention where a 3D model is displayed on a video wall, wherein the video wall is connected to an output to receive the virtual object. Also interactions and customizations are shown on the video wall. FIG 11(b) shows the video wall is made of multiple screens 1101, 1102, 1103, 1104, 1105, 1106, 1107, 1108, 1109, and receiving synchronized output regarding parts of the 3D model and interactive view of the parts of the 3D model, such that on consolidation of the screens, they behave as single screen to show interactive view of the 3D model.

FIG 12(a) to FIG 12(e) illustrates an example of the invention where a man wearing a see-through head mount display (HMD) and customizing and interacting with a virtual refrigerator. In FIG 12(a), a man is shown wearing see-through HMD 1201. In FIG 12(b), the man request for viewing a virtual refrigerator 1202 and the refrigerator 1202 appears. In FIG 12(c) and FIG 12(d), the man rotates the refrigerator 1202 in 360 degrees to be in orientation 1204 and 1205, through gesture 1203, 1206 respectively. In FIG 12(e), the man request for opening door of refrigerator 1202 through gesture 1210 and requests for options 1207, 1208, 1209 to change one of racks of the door of the refrigerator 1202. In FIG 12(f), the man choose option 1209 by gesture 1211 to replace the rack 1207 of the door of the refrigerator 1202.

FIG 13(a) to FIG 13(e) illustrates an example of the invention where a man wearing an immersive head mount display (HMD) and customizing and interacting with a virtual refrigerator. In FIG 13(a), a man is shown wearing immersive HMD 1301. In FIG 13(b), the man request for viewing a virtual refrigerator 1302 and the refrigerator 1302 appears. In FIG 13(c) and FIG 13(d), the man rotates the refrigerator 1302 in 360 degrees to be in orientation 1304 and 1305, through gesture 1303, 1306 respectively. In FIG 13(e), the man request for opening door of refrigerator 1302 through gesture 1310 and requests for options 1307, 1308, 1309 to change one of racks of the door of the refrigerator 1302. In FIG 12(f), the man chooses option 1309 by gesture 1311 to replace the rack 1307 of the door of the refrigerator 1302.

FIG 14(a) to FIG 14(d) illustrates an example of the invention where a cube based display 1401 is shown which is made of different electronic display 1402, 1403, 1404. User is seeing the car in cube 1401 which seems to be placed inside the cube due to projection while actually different screens are displaying different shape car parts. In Fig 14(b), Rendering engine/s is parting the car image in the shape of 1403′,1402′ and 1404′ there after 1403′, 1402′, 1404′ are skew to the shape of 1403, 1402 and 1404 respectively. Fig 14(c), the output from rendering engine/s is going to different display/s in the form of 1403, 1402 and 1404. Fig 14(d) shows the cube at particular orientation which gives illusion of car to be placed inside it and it can be customized by input using any input device.

The Cube can be rotated in different orientation, where change in orientation will work as rotation scene in different plane in such a way at particular orientation of cube, particular image displayed so depending on the orientation, the image is cut into one piece, two piece or three piece. These different pieces wrap themselves to fit in different display in such a way so that the cube made of such display displays a single scene which gives a feeling that the object is inside the cube. Apart from cube, even hexagonal, pentagonal, sphere shaped display with same technique can show the 3D model of the object giving feel that the 3D model is inside the display

Fig 15(a) shows a display system 1502 made of multiple display based on pepper's ghost technique. It is showing bike 1501. User see the bike from different positions 1503, 104 and 1505. Fig 15(b) show the display system 1502 is connected to the output and showing bike 1501. Fig 15(c)show that the display system 1501 show different face of bike in different display 1507, 1506 and 1508 giving an illusion of a 3d bike standing at one position showing different face from different side.

FIG 16 is a simplified block diagram showing some of the components of an example client device 1612. By way of example and without limitation, client device is a computer equipped with one or more wireless or wired communication interfaces.

As shown in FIG 16, client device 1612 may include a communication interface 1602, a user interface 1603, a processor 1604, and data storage 1605, all of which may be communicatively linked together by a system bus, network, or other connection mechanism.

Communication interface 1602 functions to allow client device 1612 to communicate with other devices, access networks, and/or transport networks. Thus, communication interface 1602 may facilitate circuit-switched and/or packet- switched communication, such as POTS communication and/or IP or other packetized communication. For instance, communication interface 1602 may include a chipset and antenna arranged for wireless communication with a radio access network or an access point. Also, communication interface 1602 may take the form of a wireline interface, such as an Ethernet, Token Ring, or USB port. Communication interface 1602 may also take the form of a wireless interface, such as a Wifi, BLUETOOTH®, global positioning system (GPS), or wide-area wireless interface (e.g., WiMAX or LTE). However, other forms of physical layer interfaces and other types of standard or proprietary communication protocols may be used over communication interface 102 Furthermore, communication interface 1502 may comprise multiple physical communication interfaces (e.g., a Wifi interface, a BLUETOOTH® interface, and a wide-area wireless interface).

User interface 1603 may function to allow client device 1612 to interact with a human or non-human user, such as to receive input from a user and to provide output to the user. Thus, user interface 1603 may include input components such as a keypad, keyboard, touch- sensitive or presence-sensitive panel, computer mouse, joystick, microphone, still camera and/or video camera, gesture sensor, tactile based input device. The input component also includes a pointing device such as mouse; a gesture guided input, or eye movement or voice command captured by a sensor , an infrared-based sensor; a touch input; input received by changing the positioning/orientation of accelerometer and/or gyroscope and/or magnetometer attached with wearable display or with mobile devices or with moving display; or a command to a virtual assistant.

User interface 1603 may also include one or more output components such as a cut to shape display screen illuminating by projector or by itself for displaying objects, cut to shape display screen illuminating by projector or by itself for displaying virtual assistant.

User interface 1603 may also be configured to generate audible output(s), via a speaker, speaker jack, audio output port, audio output device, earphones, and/or other similar devices, now known or later developed. In some embodiments, user interface 1603 may include software, circuitry, or another form of logic that can transmit data to and/ or receive data from external user input/output devices. Additionally or alternatively, client device 112 may support remote access from another device, via communication interface 1602 or via another physical interface.

Processor 1604 may comprise one or more general-purpose processors (e.g., microprocessors) and/or one or more special purpose processors (e.g., DSPs, CPUs, FPUs, network processors, or ASICs).

Data storage 1605 may include one or more volatile and/or non-volatile storage components, such as magnetic, optical, flash, or organic storage, and may be integrated in whole or in part with processor 1604. Data storage 1605 may include removable and/or non-removable components.

In general, processor 1604 may be capable of executing program instructions 1607 (e.g., compiled or non-compiled program logic and/or machine code) stored in data storage 1505 to carry out the various functions described herein. Therefore, data storage 1605 may include a non-transitory computer-readable medium, having stored thereon program instructions that, upon execution by client device 1612, cause client device 1612 to carry out any of the methods, processes, or functions disclosed in this specification and/or the accompanying drawings. The execution of program instructions 1607 by processor 1604 may result in processor 1604 using data 1606.

By way of example, program instructions 1607 may include an operating system 1611 (e.g., an operating system kernel, device driver(s), and/or other modules) and one or more application programs 1610 installed on client device 1612 Similarly, data 1606 may include operating system data 1609 and application data 1608. Operating system data 1609 may be accessible primarily to operating system 1611, and application data 1608 may be accessible primarily to one or more of application programs 1610. Application data 1608 may be arranged in a file system that is visible to or hidden from a user of client device 1612.

Application Data 1608 includes 3D model data that includes two-dimensional and/or three dimensional graphics data, texture data that includes photographs, video, interactive user controlled video, color or images, and/ or audio data, and/or virtual assistant data that include video and audio. The graphics data comprises the 3d graphics data of 3D model without those part/s which are to be customized,3D graphics data of the part/s of 3d model which are used during customization and/or 3d graphics data of complete 3D model.

In one embodiment as shown in FIG 17(a), the user controlled interaction unit 131 uses 3D model graphics data/wireframe data 132a, texture data 132b, audio data 132c along with user controlled interaction support sub-system 133 to generate the output 135, as per input request for interaction 137, using rendering engine 134. If some part is customized using another part then the interaction between part which is being customized and rest of the part is mapped to new part and rest of the part to make customized 3d model accessible for all interactions.

In another embodiment as shown in FIG 17(b), sometime when multi-display system is used to show output 135, 138 then more than one rendering engines 134 using one or more than one processing units 131 may be used to generate separate output 135, 138 which goes to different display.

Application Programs 1610 includes programs for performing the following steps, when executed over the processor:

- generating and displaying a first view of the 3D model;
- receiving an user input, the user input are one or more interaction commands, comprises interactions for customization of 3D model by atleast one of adding, removing, replacing, scaling, or changing geometry, or combination thereof, of mechanical, electronic, digital,

or pneumatic part/s of the 3D model by changing texture and/or graphics data of the part

- identifying one or more interaction commands;
- in response to the identified command/s, rendering of corresponding interaction to 3D model of object with or without sound output using texture data, computer graphics data and selectively using sound data of the 3D-model of object; and
- displaying the corresponding interaction to 3D model.

Application program 1610 further includes a set of system libraries comprises functionalities for:

- producing sound as per user-controlled interaction;
- animation of one or more parts in the 3D model;
- providing functionality of operation of electronic or digital parts in the displayed 3D model/s depending on the characteristics, state and nature of displayed object;
- decision making and prioritizing user-controlled interactions response;
- putting more than one 3D model/s in scene;
- generating surrounding or terrain around the 3D model;
- generating effect of dynamic lighting on the 3D model;
- providing visual effects of color shades; and
- generating real-time simulation effect;

Rendering of corresponding interaction to 3D model of object in a way for displaying in a display system made of one or more electronic visual display or projection based display or combination thereof.

The display system can be a wearable display or a non-wearable display or combination thereof.

The non-wearable display includes electronic visual displays such as LCD, LED, Plasma, OLED, video wall, box shaped display or display made of more than one electronic visual display or projector based or combination thereof.

The non-wearable display also includes a pepper's ghost based display with one or more faces made up of transparent inclined foil/screen illuminated by projector/s and/or electronic display/s wherein projector and/or electronic display showing different image of same virtual object rendered with different camera angle at different faces of pepper's ghost based display giving an illusion of a virtual object placed at one places whose different sides are viewable through different face of display based on pepper's ghost technology.

The wearable display includes head mounted display. The head mount display includes either one or two small displays with lenses and semi-transparent mirrors embedded in a helmet, eyeglasses or visor. The display units are miniaturised and may include CRT, LCDs, Liquid crystal on silicon (LCos), or OLED or multiple micro-displays to increase total resolution and field of view.

The head mounted display also includes a see through head mount display or optical head-mounted display with one or two display for one or both eyes which further comprises curved mirror based display or waveguide based display. See through head mount display are transparent or semi transparent display which shows the 3d model in front of users eye/s while user can also see the environment around him as well.

The head mounted display also includes video see through head mount display or immersive head mount display for fully 3D viewing of the 3D-model by feeding rendering of same view with two slightly different perspective to make a complete 3D viewing of the 3D- model. Immersive head mount display shows 3d model in virtual environment which is immersive.

In one embodiment, the 3D model moves relative to movement of a wearer of the head-mount display in such a way to give to give an illusion of 3D model to be intact at one place while other sides of 3D model are available to be viewed and interacted by the wearer of head mount display by moving around intact 3D model.

The display system also includes a volumetric display to display the 3D model and interaction in three physical dimensions space, create 3-D imagery via the emission, scattering, beam splitter or through illumination from well-defined regions in three dimensional space, the volumetric 3-D displays are either auto stereoscopic or auto multiscopic to create 3-D imagery visible to an unaided eye, the volumetric display further comprises holographic and highly multiview displays displaying the 3D model by projecting a three-dimensional light field within a volume.

The input command to the said virtual assistant system is a voice command or text or gesture based command. The virtual assistant system includes a natural language processing component for processing of user input in form of words or sentences and artificial intelligence unit using static/dynamic answer set database to generate output in voice/text based response and/or interaction in 3D model.

Other types of user controlled interactions are as follows:

- interactions for colour change of displayed 3D model,
- operating movable external parts of the 3D model,
- operating movable internal parts of the 3D model,
- interaction for getting un-interrupted view of interior or accessible internal parts of the 3D model,
- transparency-opacity effect for viewing internal parts and different parts that are inaccessible,
- replacing parts of displayed object with corresponding new parts having different texture,
- interacting with displayed object having electronic display parts for understanding electronic display,
- operating system functioning, vertical tilt interaction and/or horizontal tilt interaction,
- operating the light-emitting parts of 3D model of object for functioning of the light emitting parts,
- interacting with 3D model for producing sound effects,
- engineering disintegration interaction with part of the 3D model for visualizing the part within boundary of the cut-to-screen, the part is available for visualization only by dismantling the part from the entire object,

- time bound change based interactions to represent of changes in the 3D model demonstrating change in physical property of object in a span of time on using or operating of the object,
- physical property based interactions to a surface of the 3D model, wherein physical property based interactions are made to asses a physical property of the surface of the 3D model
- real environment mapping based interaction, which includes capturing an area in vicinity of the user, mapping and simulating the video/ image of area of vicinity on a surface of the 3D model
- addition based interaction for attaching or adding a part to the virtual model,
- deletion based interaction for removing a part of 3D model,
- interactions for replacing the part of the 3D model,
- demonstration based interactions for requesting demonstration of operation of the part/s of the object which are operated in an ordered manner to perform a particular operation,
- linked-part based interaction, such that when an interaction command is received for operating one part of 3D model, than in response another part linked to the operating part is shown operating in the 3D model along with the part for which the interaction command was received,
- liquid and fumes flow based interaction for visualizing liquid and fumes flow in the 3D model with real-like texture in real-time

- immersive interactions, where users visualize their own body performing user-controlled interactions with the virtual computer model.

The displayed 3D model is preferably a life-size or greater than life-size representation of real object.

**WE CLAIM,**

1. A computer implemented method for visualization of a 3D model of an object, the method comprising:
- generating and displaying a first view of the 3D-model;
- receiving an user input, the user input are one or more interaction commands comprises interactions for customization of 3D model by atleast one of adding, removing, replacing, scaling, or changing geometry, or combination thereof, of mechanical, electronic, digital, or pneumatic part/s of the 3D model by changing texture and/or graphics data of the part
- identifying one or more interaction commands;
-in response to the identified command/s, rendering of corresponding interaction to 3D model of object with or without sound output using texture data, computer graphics data and selectively using sound data of the 3D-model of object; and
- displaying the corresponding interaction to 3D- model.

2. The method according to claim 1, wherein customization by adding comprises adding one or more new part/s to the 3D model at a predefined appropriate position.

3. The method according to any of the claims 1 or 2, wherein customization by replacing and/or removing is performed on a predefined part/s.

4. The method according to any of the claims 1 to 3, wherein customization by scaling is performed on a predefined part and/or to a predefined limit.

5. The method according to any of the claims 1 to 4, wherein the part of 3D model can be customized by shape in particular geometry of predefined options.

6. The method according to any of the claims 1 to 5, wherein the 3D- model after customization is adapted to behave as an entity, in the same way as the 3D model was behaving before customization, so as the 3D model after customization is viewable from all angles.

7. The method according to any of the claims 1 to 6, wherein the customization is adapted to be performed in any angular orientation of the 3D model.

8. The method according to claims 1 to 7, wherein the interaction command comprises extrusive interaction and/or intrusive interactions and/or a time bound change based interaction and/or a real environment mapping based interaction and combination thereof, as per user choice and/ or as per characteristics, state and nature of the said object,
wherein the time bound changes refers to representation of changes in 3D model demonstrating change in physical property of object in a span of time on using or operating of the object, and real environment mapping refers to capturing a real time environment, mapping and simulating the real time environment to create a simulated environment for interacting with the 3D model.

9. The method according to claim 8, wherein the interaction commands are adapted to be received before

customization and/or during customization and/or after customization.

10. The method according to claim 8 or 9, wherein the extrusive interaction comprises atleast one of:

- interacting with a 3D model representing an object having a display for experiencing functionality of Virtual GUI on virtual display of displayed 3D model; to produce the similar changes in corresponding GUI of 3D model as in GUI of the object for similar input;
- interacting for operating and/or removing movable parts of the 3D model of the object, wherein operating the movable parts comprises sliding, turning, angularly moving, opening, closing, folding, and inflating-deflating the parts
- interacting with 3D model of object for rotating the 3D model in 360 degree in different planes;
- operating the light-emitting parts of 3D-model of object for experiencing functioning of the light emitting part/s, the functioning of the light emitting part/s comprises glowing or emission of the light from light emitting part/s in 3D-model in similar pattern that of light emitting part/s of the object;
- interacting with 3D-model of object having representation of electronic display part/s of the object to display response in electronic display part of 3D- model similar to the response to be viewed in electronic display part/s of the object upon similar interaction;
- interacting with 3D-model of object having representation of electrical/electronic control of the object to display response in the 3D-model similar to the

response to be viewed in the object upon similar interaction;
- interacting with 3D- model for producing sound effects;
or
combination thereof.

11. The method according to the claim, wherein functioning of light emitting part is shown by a video as texture on surface of said light emitting part to represent lighting as dynamic texture change.

12. The method according to any of the claims 8 to 11, the intrusive interactions comprises atleast one of:
- interacting with sub-parts of the 3D- model of the object, wherein sub-parts are those parts of the 3D-model which are moved and/ or slided and/or rotated and/or operated for using the object;
- interacting with internal parts of the 3D model, wherein the internal parts of the 3D -model represent parts of the object which are responsible for working of object but not required to be interacted for using the object, wherein interacting with internal parts comprising removing and/or disintegrating and-/or operating and/or rotating of the internal parts;
- interacting for receiving an un-interrupted view of the interior of the 3D model of the object and/ or the sub-parts;
- interacting with part/s of the 3D model for visualizing the part by dismantling the part from the entire object;
- interacting for creating transparency-opacity effect for converting the internal part to be viewed as opaque

and remaining 3D model as transparent or nearly transparent;
- disintegrating different parts of the object in exploded view; or
combination thereof.

13. The method according to any of the claims 8 to 12, wherein the real environment mapping based interactions comprises atleast one of:
- capturing an area in vicinity of the user, mapping and simulating the video/ image of area of vicinity on a surface of 3D model to provide a mirror effect;
- capturing an area in vicinity of the user, mapping and simulating the video/ image of area of vicinity on a 3D space where 3D model is placed; or
combination thereof.

14. The method according to any of the claims 1 to 13, wherein the interaction comprises liquid and fumes flow based interaction for visualizing liquid and fumes flow in the 3D model with real-like texture in real-time.

15. The method according to any of the claims 1 to 14, wherein the interaction comprises immersive interactions, the immersive interactions are defined as interactions where users visualize their own body performing user-controlled interactions with the virtual computer model.

16. The method according to any of the claims 1 or 15, wherein displaying of new interaction/s to the 3D-model while previously one or more interaction has been

performed or another interaction/s is being performed on the 3-D model.

17. The method according to any of the claims 1 to 16, wherein rendering of corresponding interaction to 3D model of object in a way for displaying in a display system made of one or more electronic visual display or projection based display or combination thereof.

18. The method according to the claim 17, wherein the display system is a wearable display or a non-wearable display or combination thereof.

19. The method according to the claim 18, wherein the non-wearable display comprises electronic visual displays such as LCD, LED, Plasma, OLED, video wall, box shaped display or display made of more than one electronic visual display or projector based or combination thereof.

20. The method according to the claim 18, wherein the non-wearable display comprises a pepper's ghost based display with one or more faces made up of transparent inclined foil/screen illuminated by projector/s and/or electronic display/s wherein projector and/or electronic display showing different image of same virtual object rendered with different camera angle at different faces of pepper's ghost based display giving an illusion of a virtual object placed at one places whose different sides are viewable through different face of display based on pepper's ghost technology.

21. The method according to the claim 18, wherein the wearable display comprises head mounted display, the head mount display comprises either one or two small displays with lenses and semi-transparent mirrors embedded in a helmet, eyeglasses or visor. The display units are miniaturised and may include CRT, LCDs, Liquid crystal on silicon (LCos), or OLED or multiple micro-displays to increase total resolution and field of view.

22. The method according to the claim 21, wherein the head mounted display comprises a see through head mount display or optical head-mounted display with one or two display for one or both eyes which further comprises curved mirror based display or waveguide based display.

23. The method according to the claim 21, wherein the head mounted display comprises video see through head mount display or immersive head mount display for fully 3D viewing of the 3D-model by feeding rendering of same view with two slightly different perspective to make a complete 3D viewing of the 3D- model.

24. The method according to any of the claims 22 or 23, wherein the 3D model moves relative to movement of a wearer of the head-mount display in such a way to give to give an illusion of 3D model to be intact at one place while other sides of 3D model are available to be viewed and interacted by the wearer of head mount display by moving around intact 3D model.

25. The method according to the claim 17, wherein the display system comprises a volumetric display to display

the 3D model and interaction in three physical dimensions space, create 3-D imagery via the emission, scattering, beam splitter or through illumination from well-defined regions in three dimensional space, the volumetric 3-D displays are either auto stereoscopic or auto multiscopic to create 3-D imagery visible to an unaided eye, the volumetric display further comprises holographic and highly multiview displays displaying the 3D model by projecting a three-dimensional light field within a volume.

26. The method according to claim 17, wherein the display system comprises more than one electronic display/projection based display joined together at an angle to make an illusion of showing the 3D model inside the display system, wherein the 3D model is parted off in one or more parts, thereafter parts are skew in shape of respective display and displaying the skew parts in different displays to give an illusion of 3d model being inside display system.

27. The method according to any of the claims 1 to 26, wherein the input command is received from one or more of a pointing device such as mouse; a keyboard; a gesture guided input or eye movement or voice command captured by a sensor , an infrared-based sensor; a touch input; input received by changing the positioning/orientation of accelerometer and/or gyroscope and/or magnetometer attached with wearable display or with mobile devices or with moving display; or a command to a virtual assistant.

28. The method according to claim 27, wherein command to the said virtual assistant system is a voice command or text or gesture based command, wherein virtual assistant system comprises a natural language processing component for processing of user input in form of words or sentences and artificial intelligence unit using static/dynamic answer set database to generate output in voice/text based response and/or interaction in 3D model.

29. A system of user-controlled realistic 3D simulation for enhanced object viewing and interaction experience comprising:

- one or more input devices;
- a display device;
- a computer graphics data related to graphics of the 3D model of the object, a texture data related to texture of the 3D model, and/or an audio data related to audio production by the 3D model which is stored in one or more memory units; and
- machine-readable instructions that upon execution by one or more processors cause the system to carry out operations comprising:
  - generating and displaying a first view of the 3D model;
  - receiving an user input, the user input are one or more interaction commands, comprises interactions for customization of 3D model by atleast one of adding, removing, replacing, scaling, or changing geometry, or combination thereof, of mechanical, electronic, digital, or pneumatic part/s of the 3D model by changing texture and/or graphics data of the part
  - identifying one or more interaction commands;

- in response to the identified command/s, rendering of corresponding interaction to 3D model of object with or without sound output using texture data, computer graphics data and selectively using sound data of the 3D- model of object; and
- displaying the corresponding interaction to 3D model.

30. A computer program product stored on a computer readable medium and adapted to be executed on one or more processors, wherein the computer readable medium and the one or more processors are adapted to be coupled to a communication network interface, the computer program product on execution to enable the one or more processors to perform following steps comprising:
- generating and displaying a first view of the 3D model;
- receiving an user input, the user input are one or more interaction commands, comprises interactions for customization of 3D model by atleast one of adding, removing, replacing, scaling, or changing geometry, or combination thereof, of mechanical, electronic, digital, or pneumatic part/s of the 3D model by changing texture and/or graphics data of the part
- identifying one or more interaction commands;
in response to the identified command/s, rendering of corresponding interaction to 3D model of object with or without sound output using texture data, computer graphics data and selectively using sound data of the 3D-model of object; and
- displaying the corresponding interaction to 3D model.

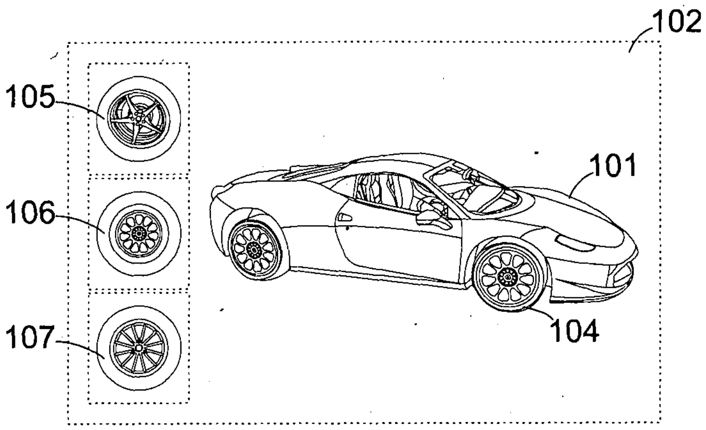


FIG. 1(a)

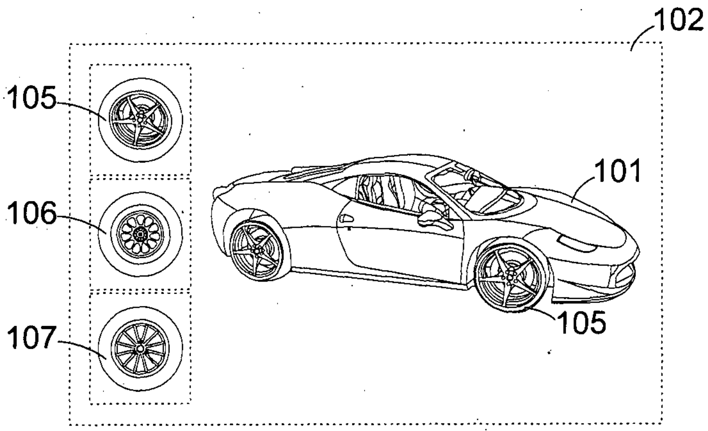


FIG. 1(b)

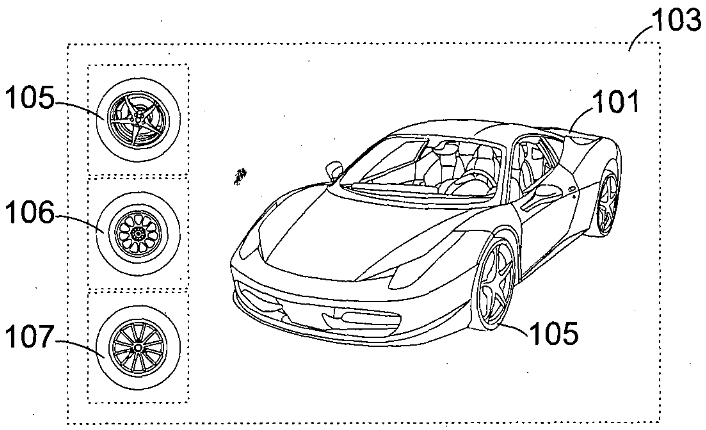


FIG. 1(c)

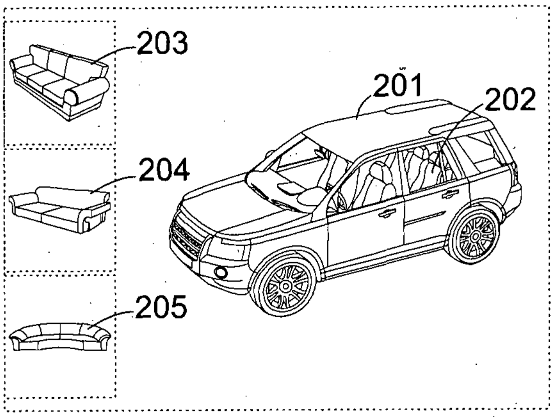


FIG. 2(a)

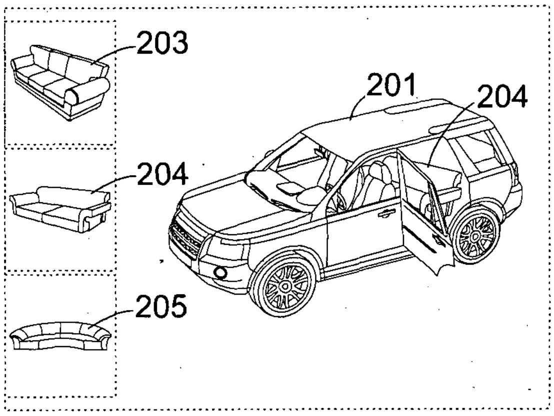


FIG. 2(b)

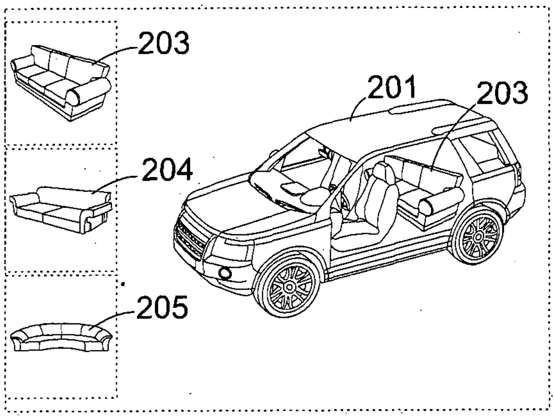


FIG. 2(c)

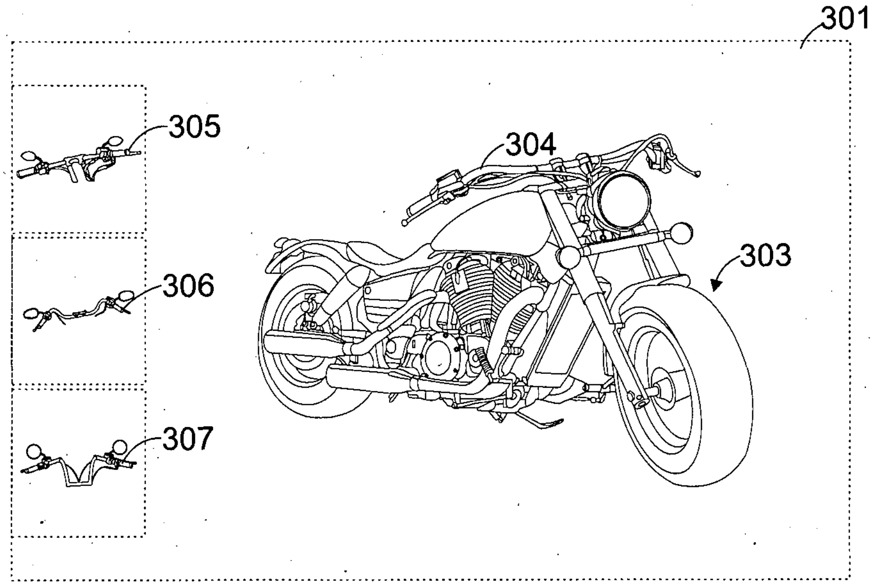


FIG. 3(a)

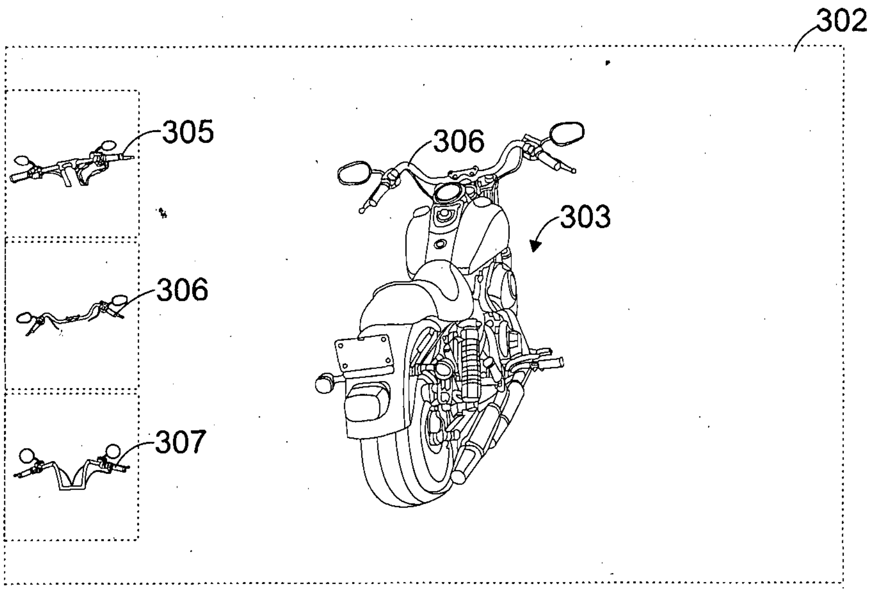


FIG. 3(b)

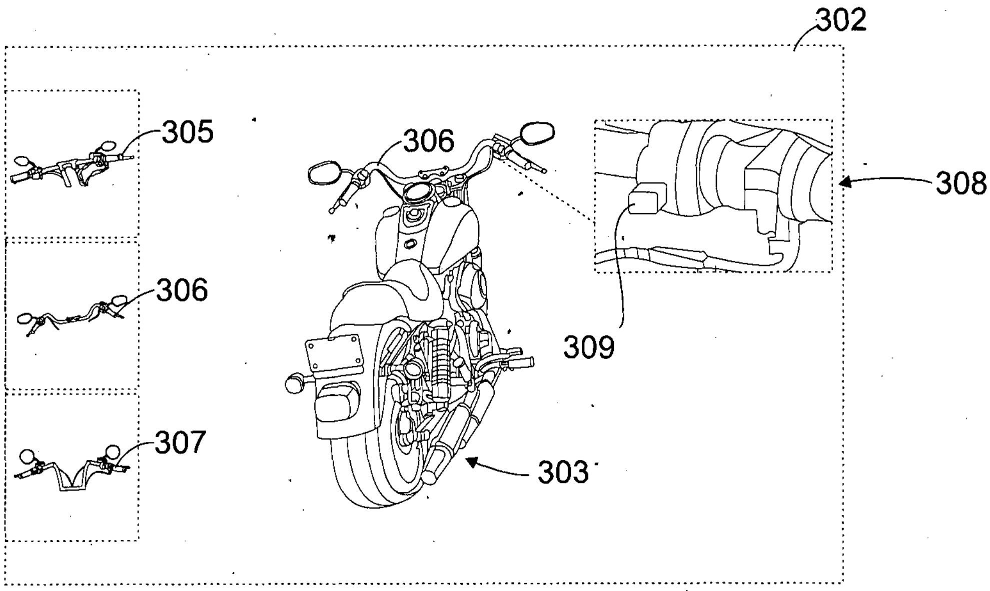
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FIG. 3(c)

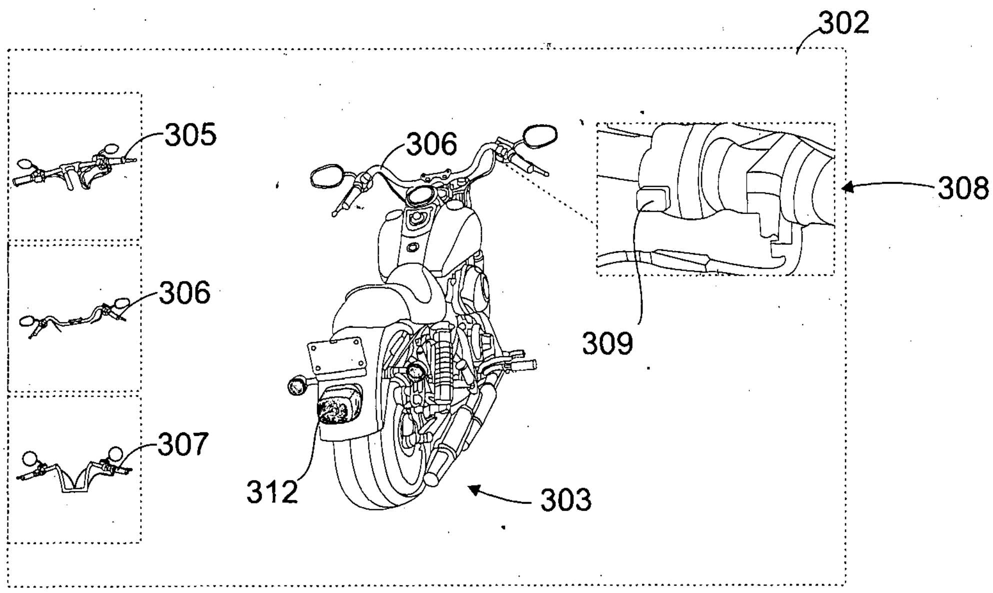
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FIG. 3(d)

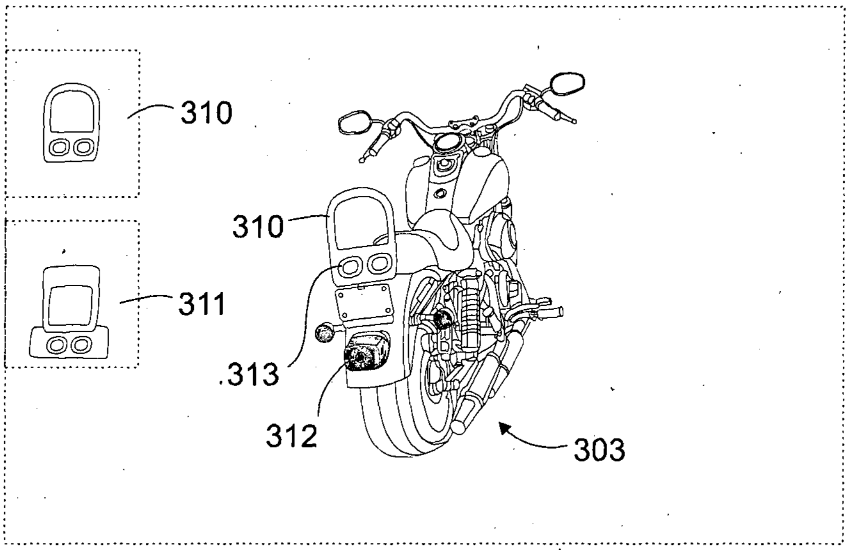



FIG. 3(e)

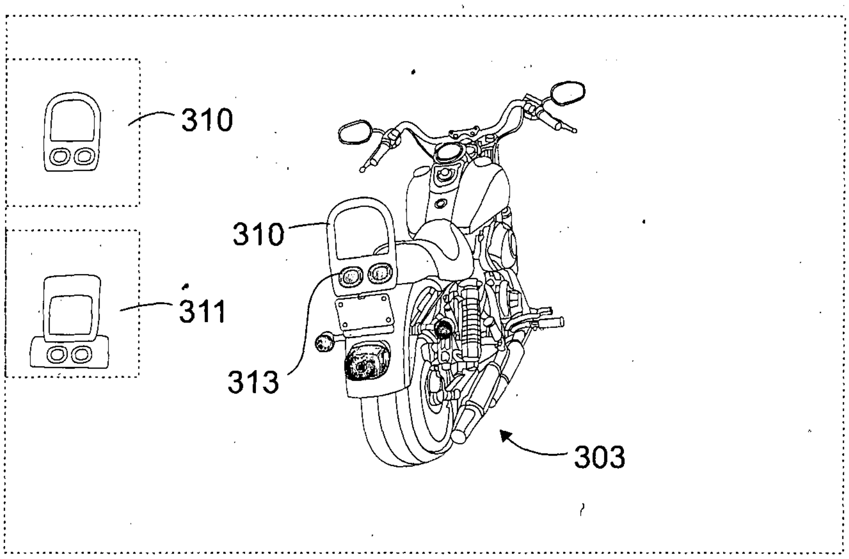



FIG. 3(f)

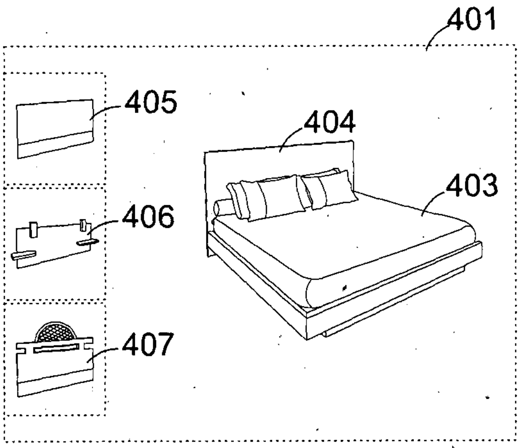



FIG. 4(a)

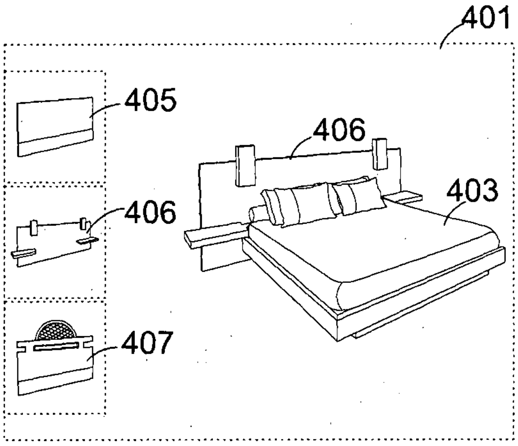



FIG. 4(b)

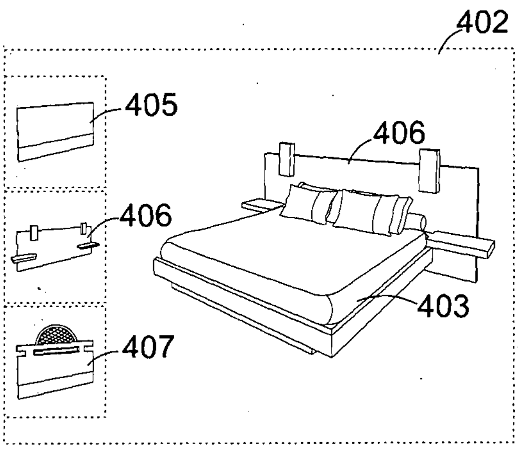



FIG. 4(c)

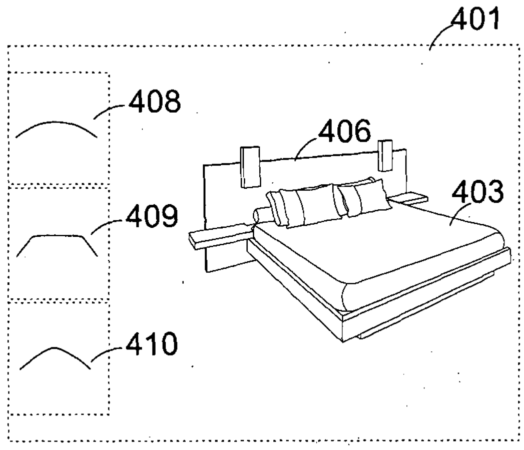



FIG. 4(d)

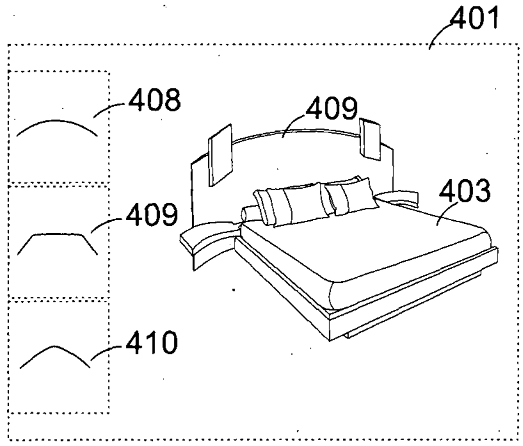



FIG. 4(e)

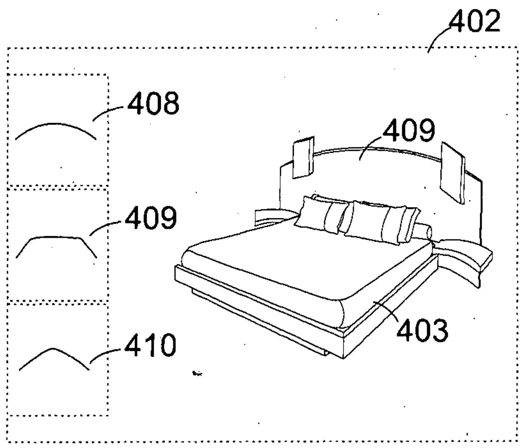



FIG. 4(f)

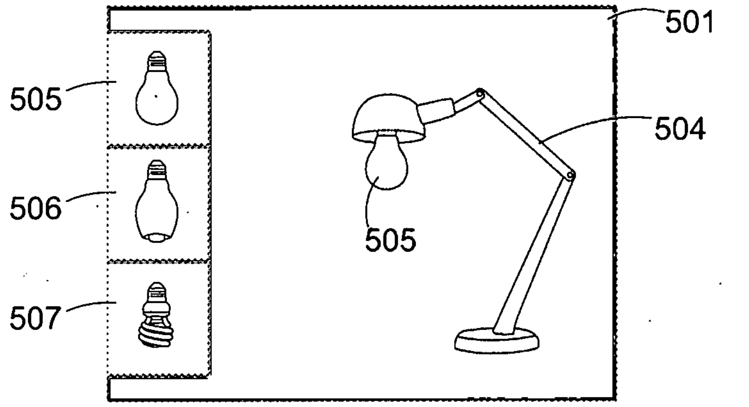



FIG. 5(a)

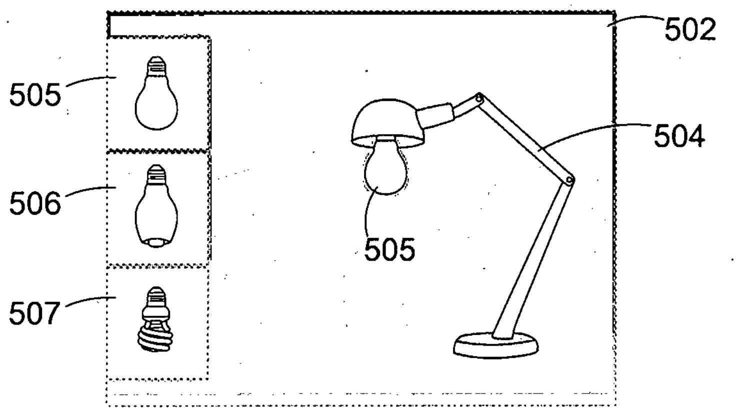



FIG. 5(b)

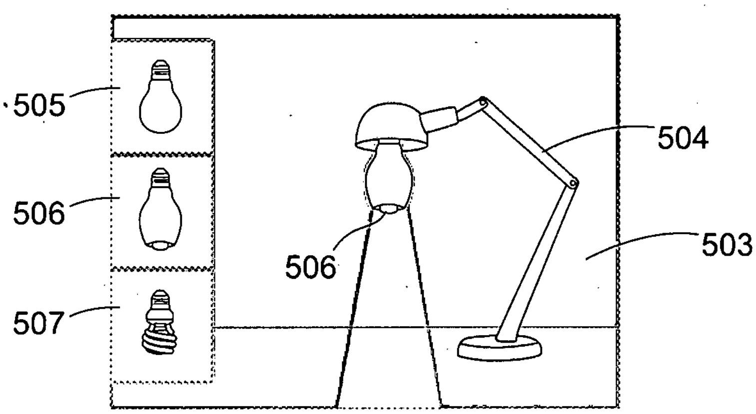



FIG. 5(c)

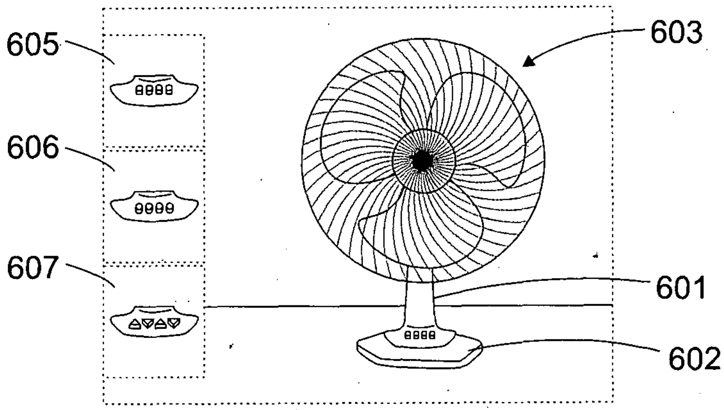



FIG. 6(a)

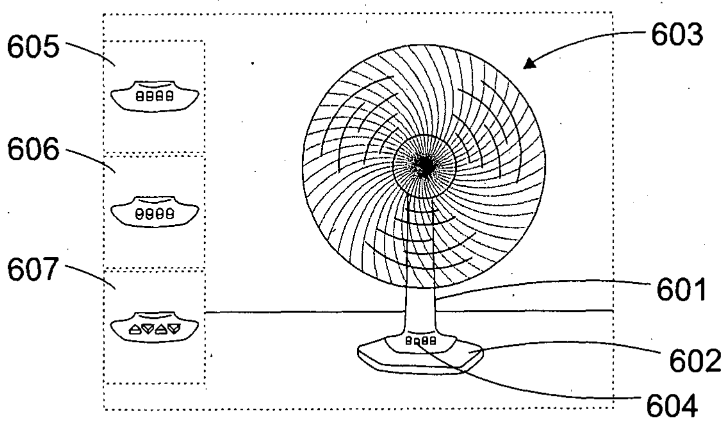



FIG. 6(b)

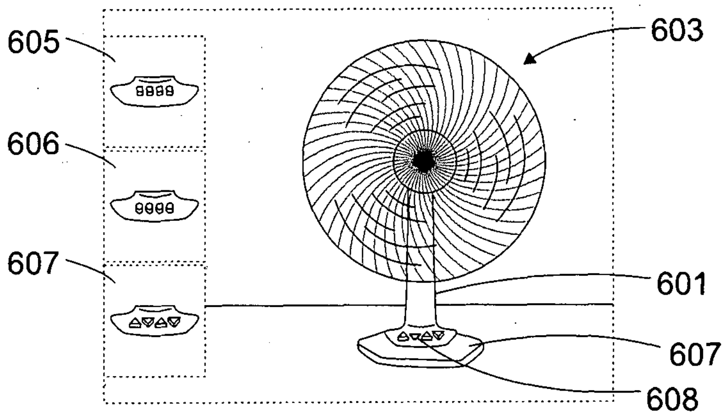



FIG. 6(c)

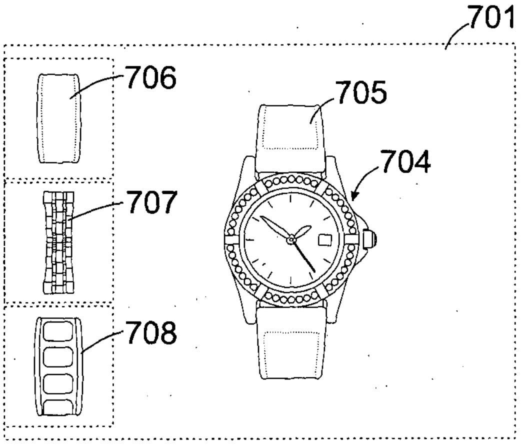



FIG. 7(a)

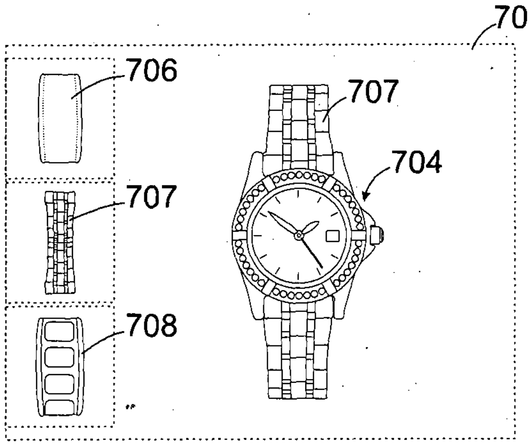



FIG. 7(b)

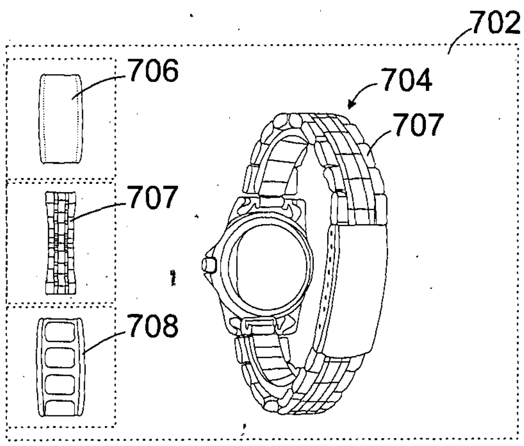



FIG. 7(c)

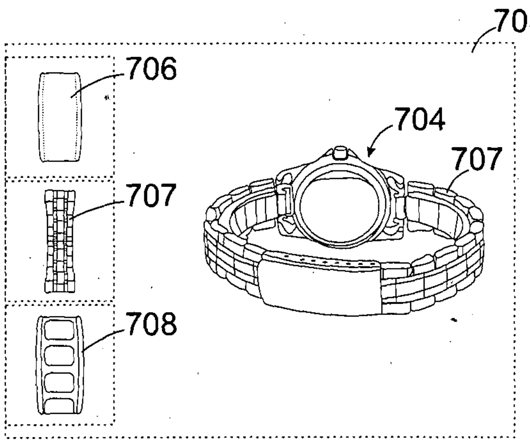



FIG. 7(d)

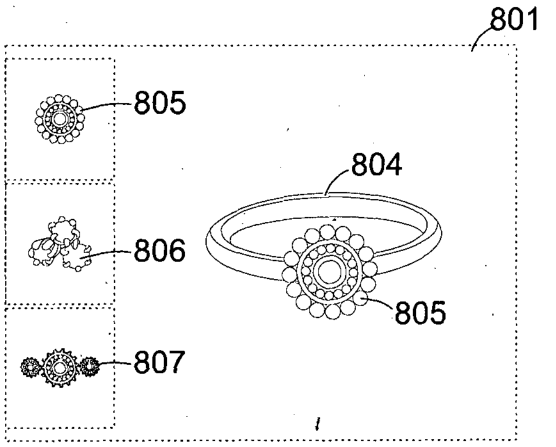



FIG. 8(a)

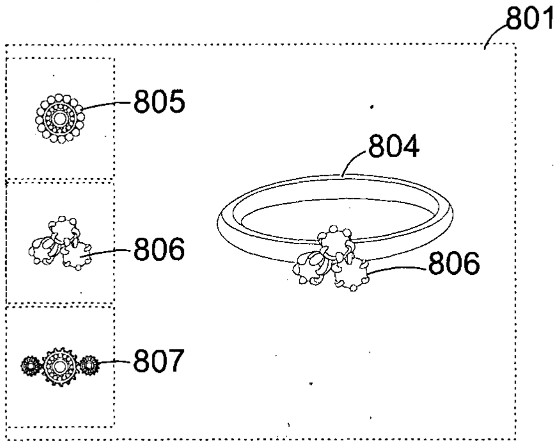



FIG. 8(b)

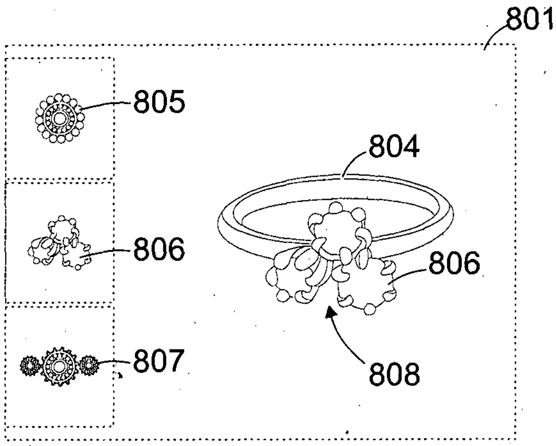



FIG. 8(c)

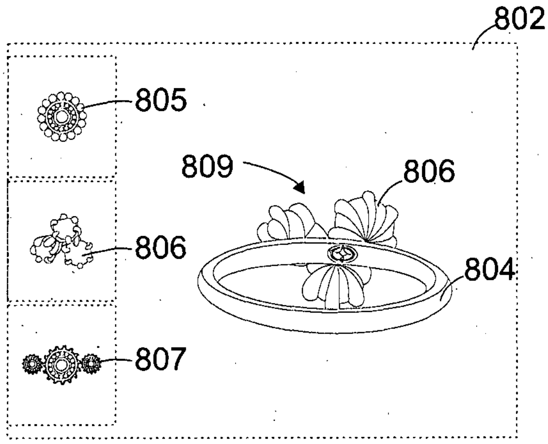



FIG. 8(d)

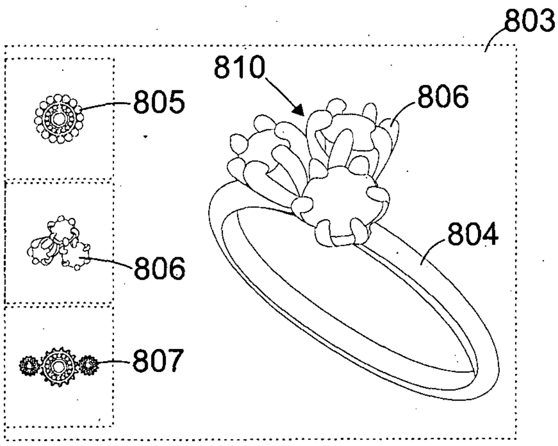



FIG. 8(e)

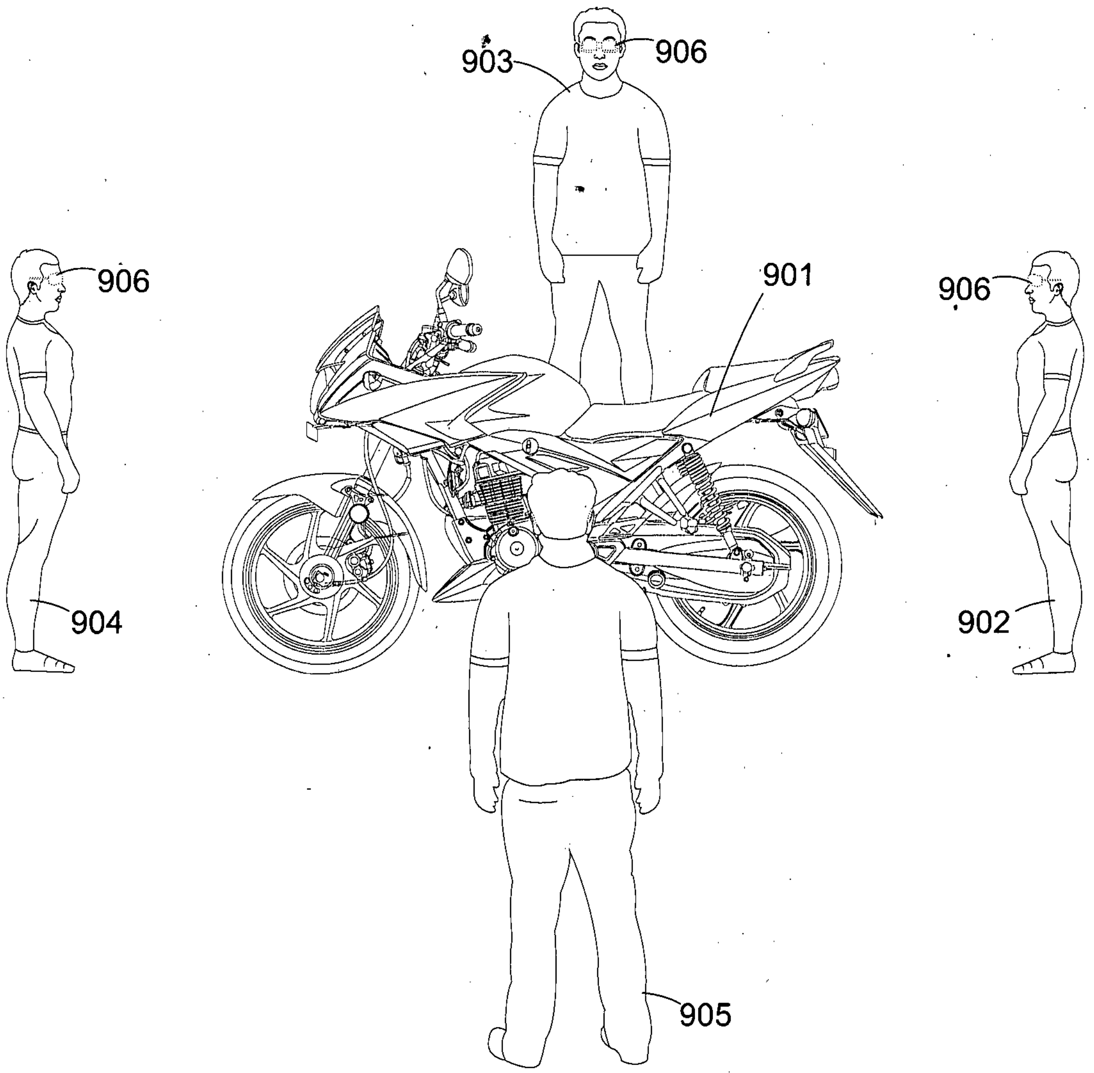



FIG. 9(a)

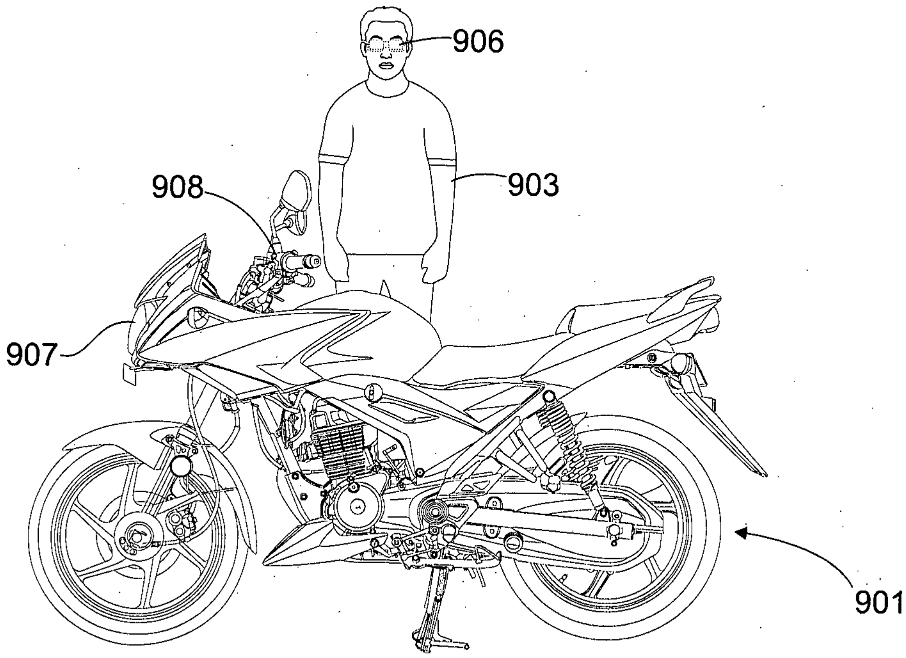



FIG. 9(b)

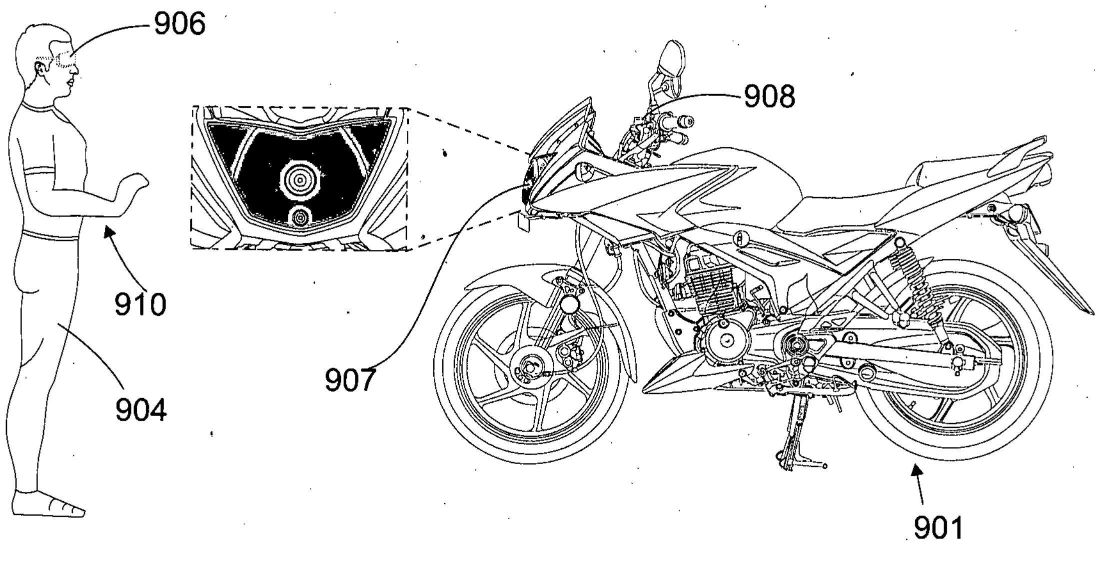



FIG. 9(c)

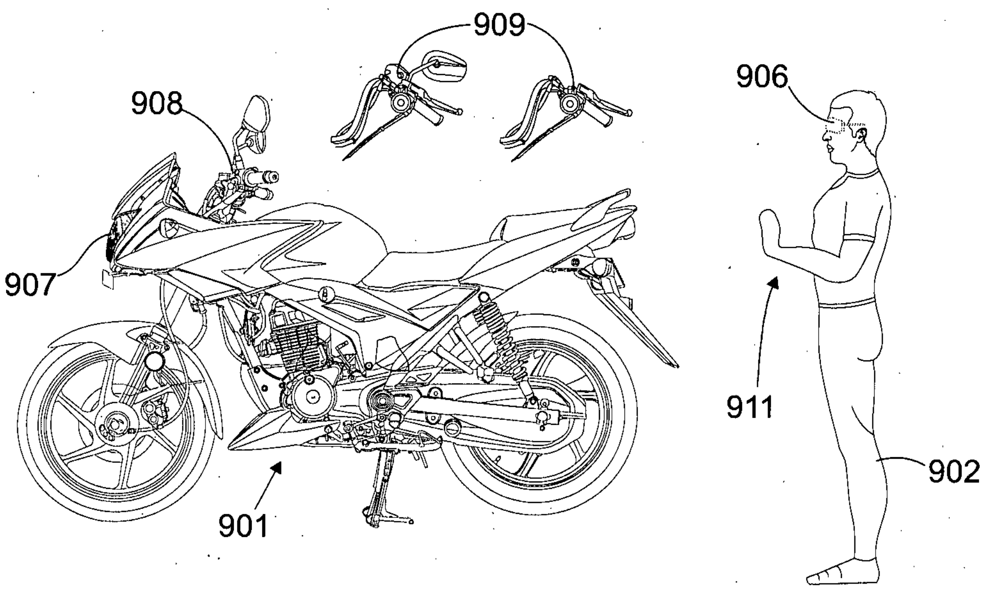



FIG. 9(d)

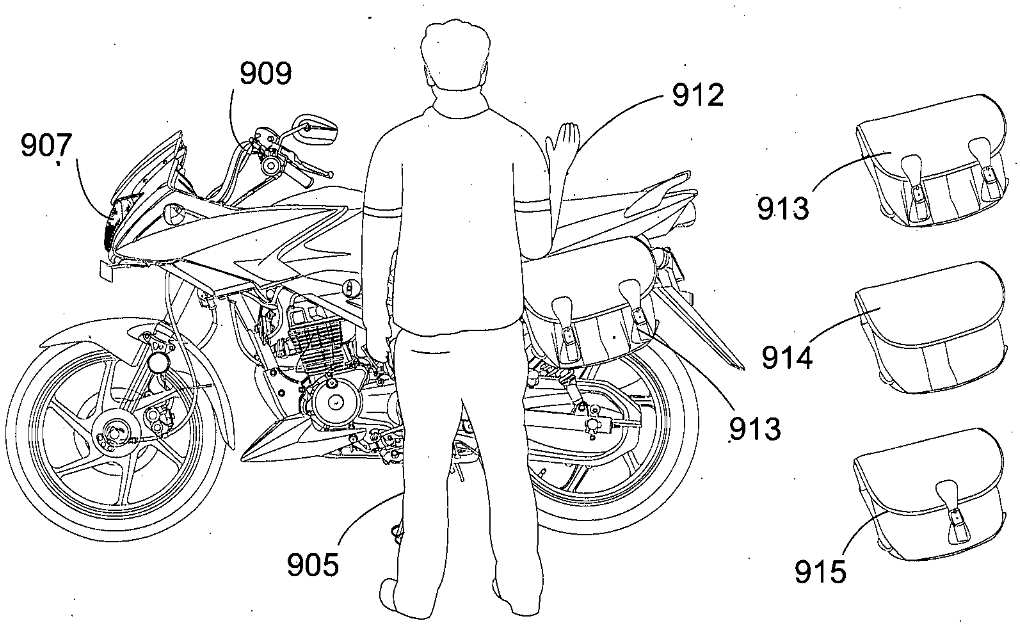



FIG. 9(e)

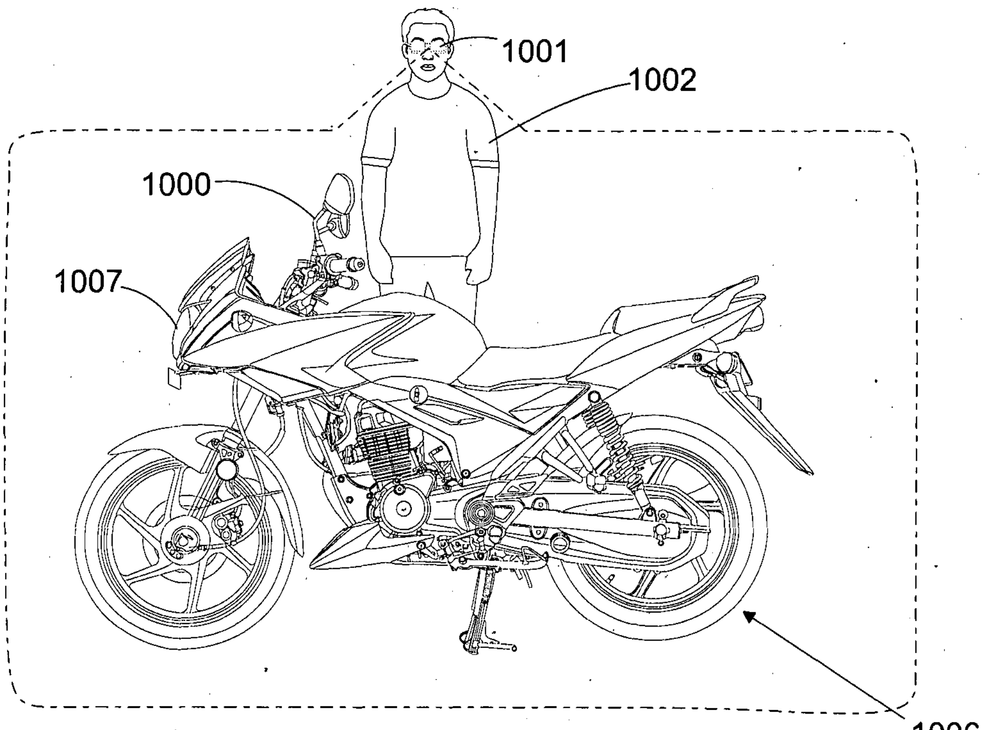



FIG. 10(a)

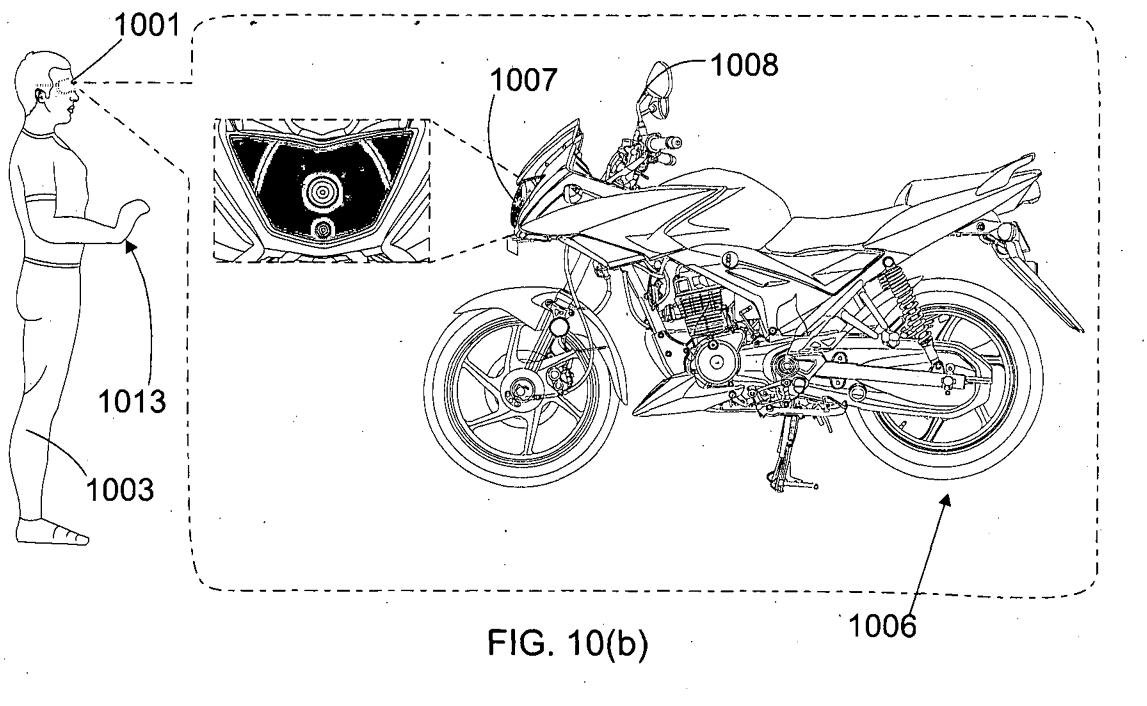



FIG. 10(b)

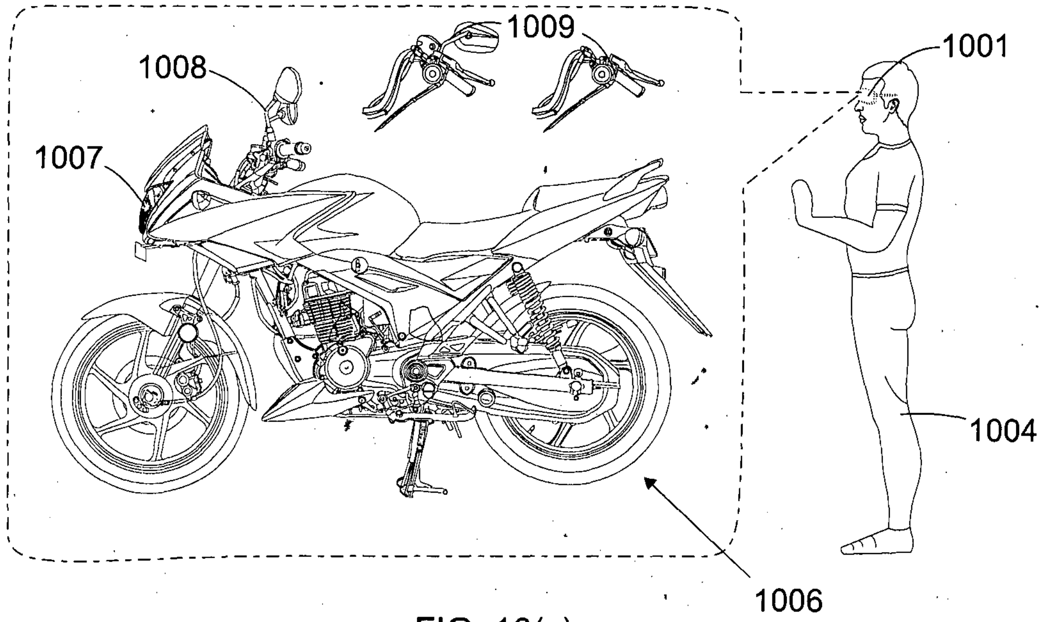



FIG. 10(c)

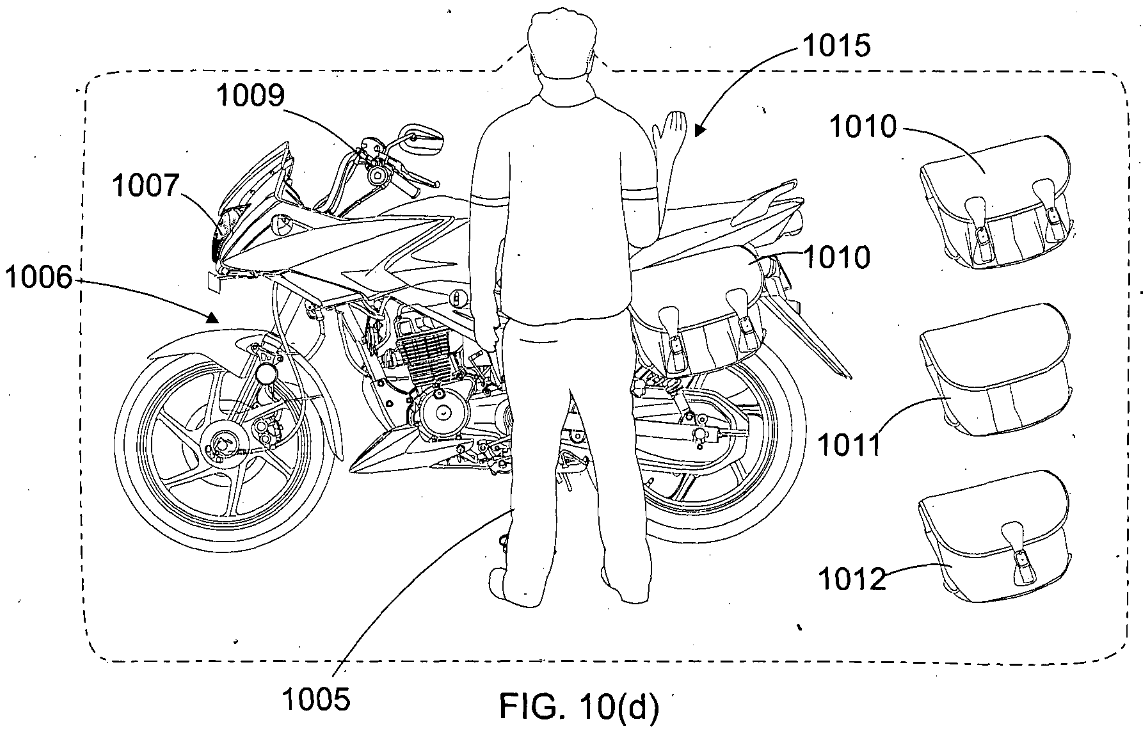



FIG. 10(d)

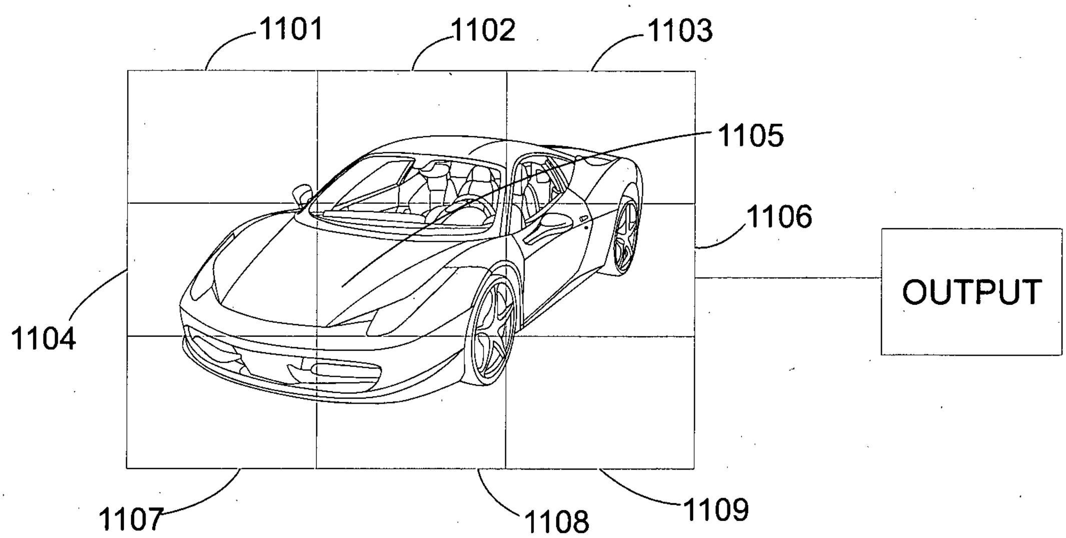



FIG. 11(a)

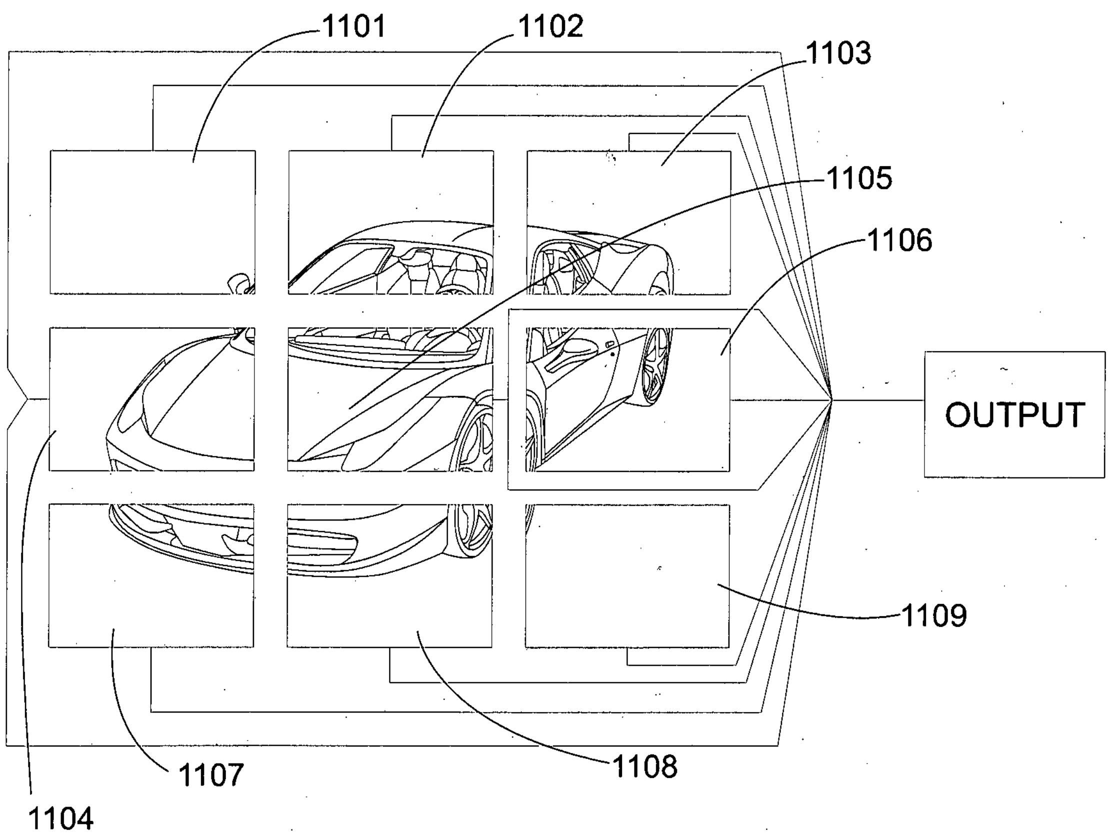



FIG. 11(b)

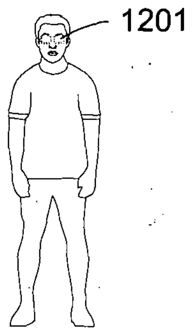



FIG. 12(a)

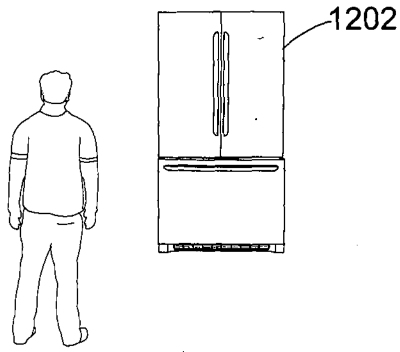



FIG. 12(b)

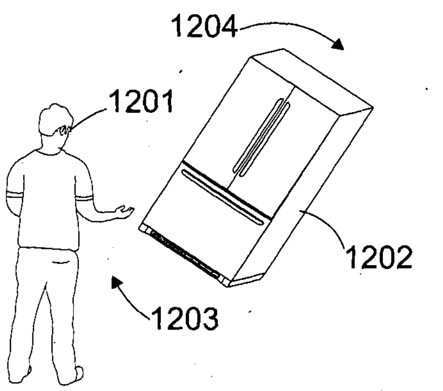



FIG. 12(c)

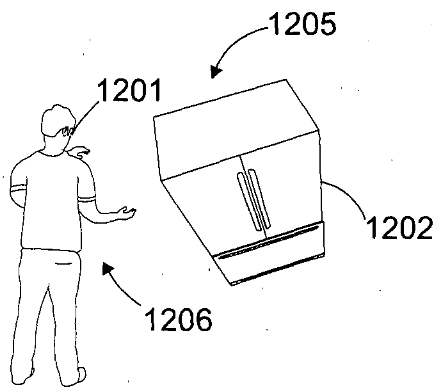



FIG. 12(d)

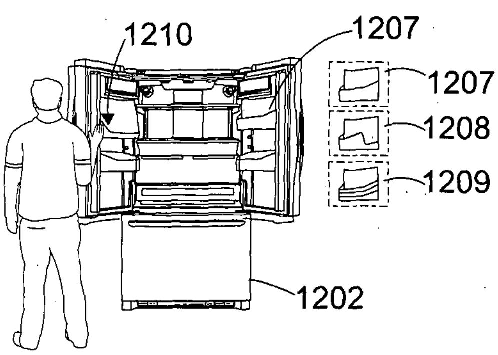



FIG. 12(e)

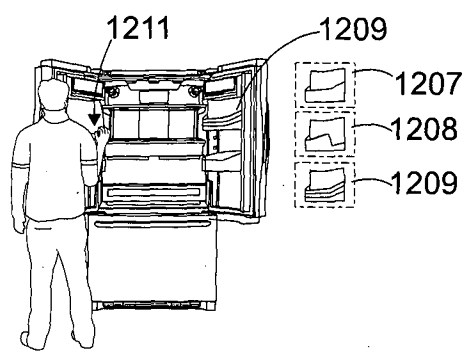



FIG. 12(f)

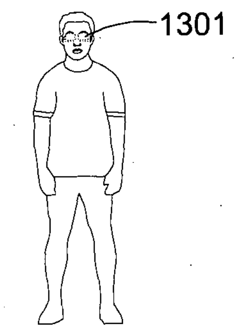



FIG. 13(a)

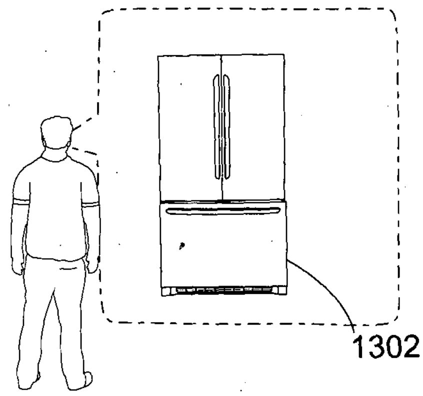



FIG. 13(b)

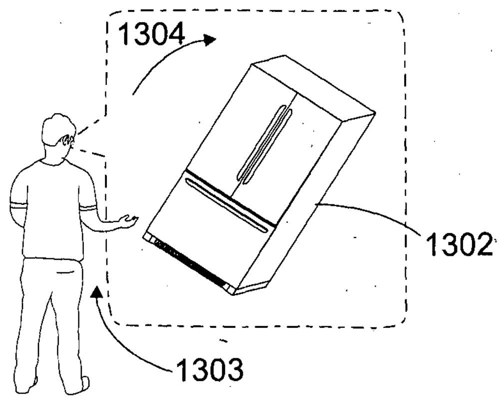



FIG. 13(c)

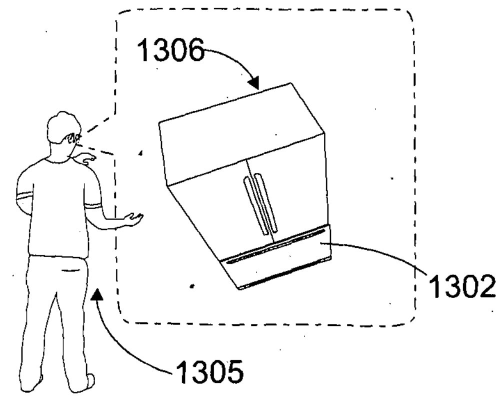



FIG. 13(d)

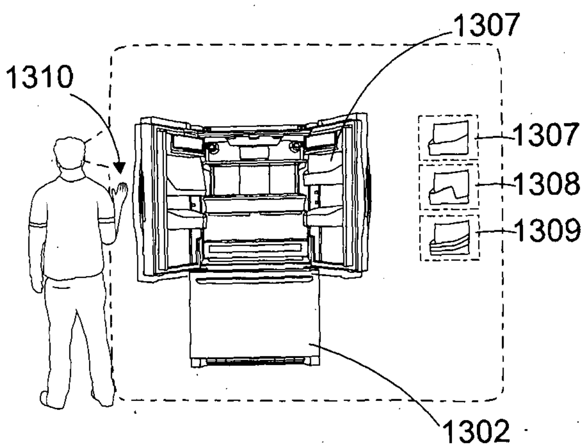



FIG. 13(e)

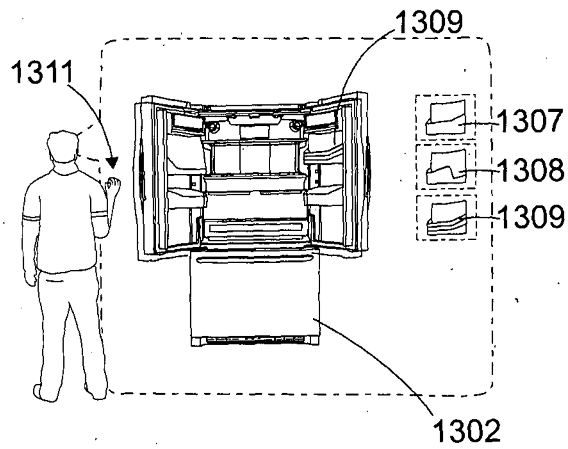



FIG. 13(f)

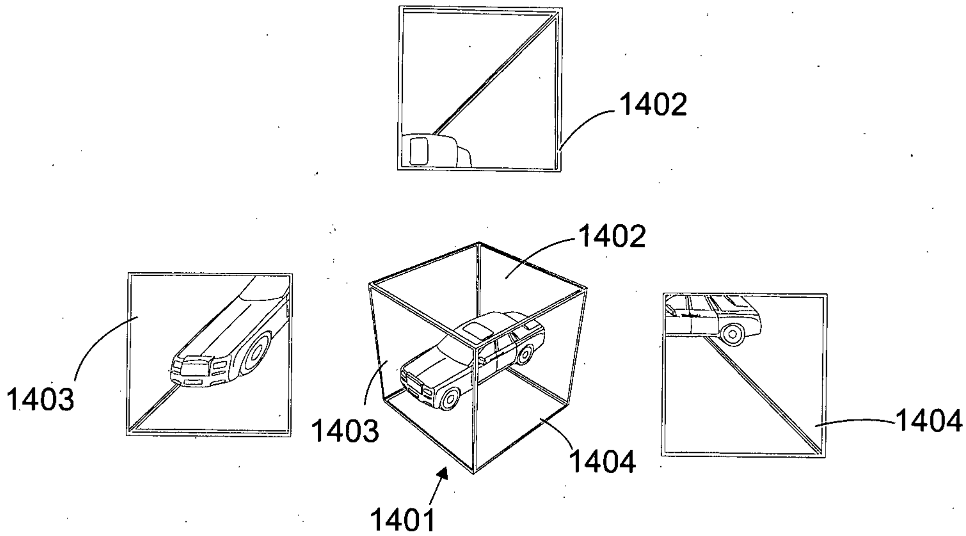



FIG. 14(a)

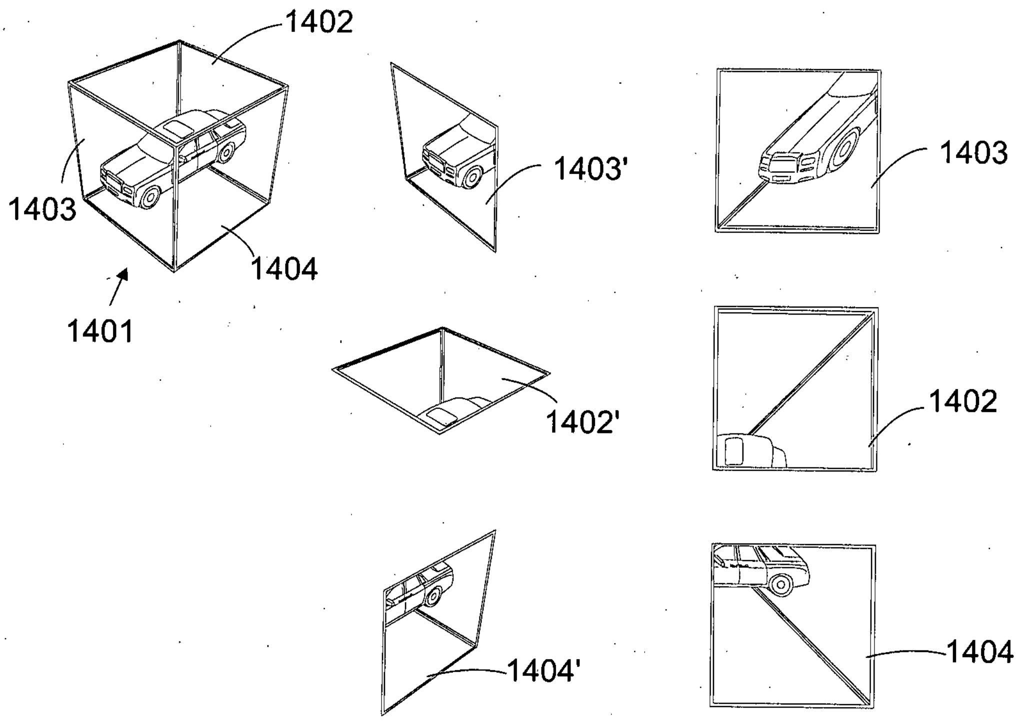



FIG. 14(b)

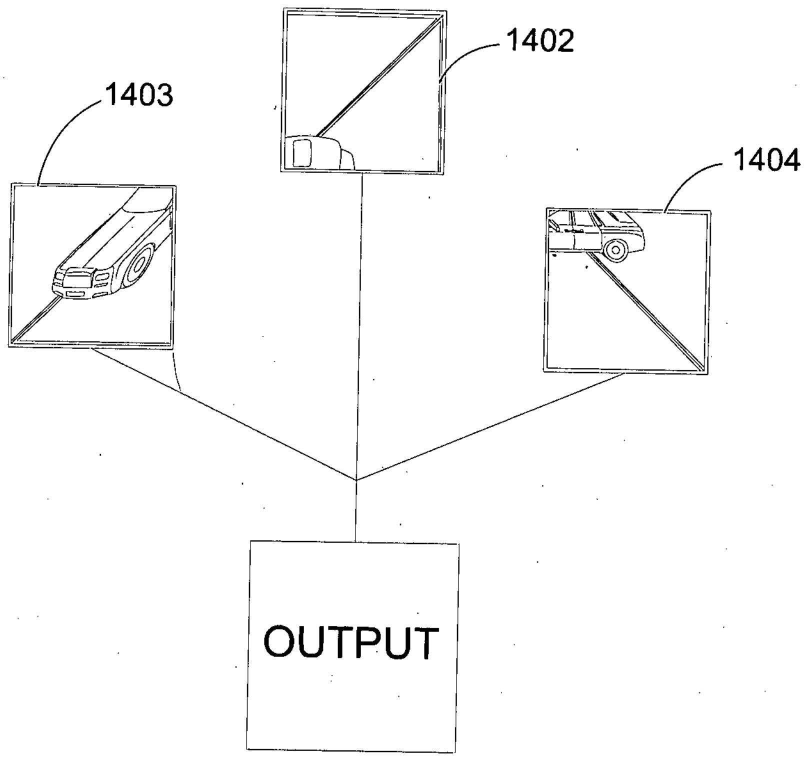



FIG. 14(c)

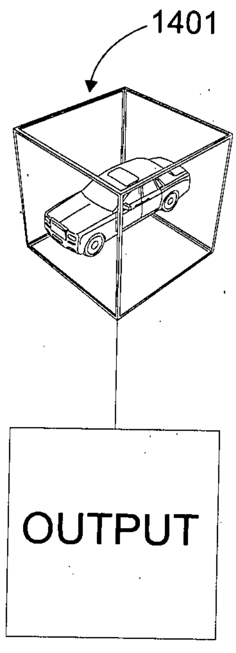



FIG. 14(d)

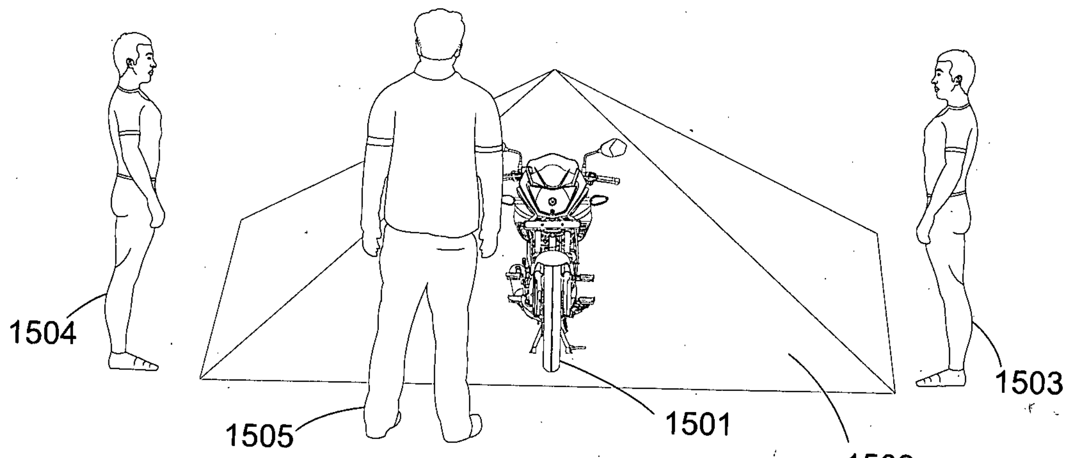



FIG. 15(a)

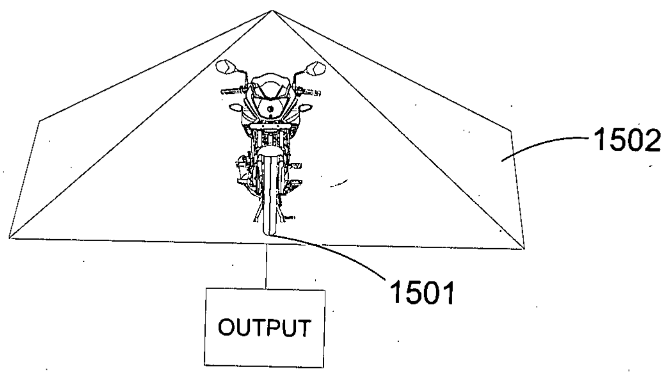



FIG. 15(b)

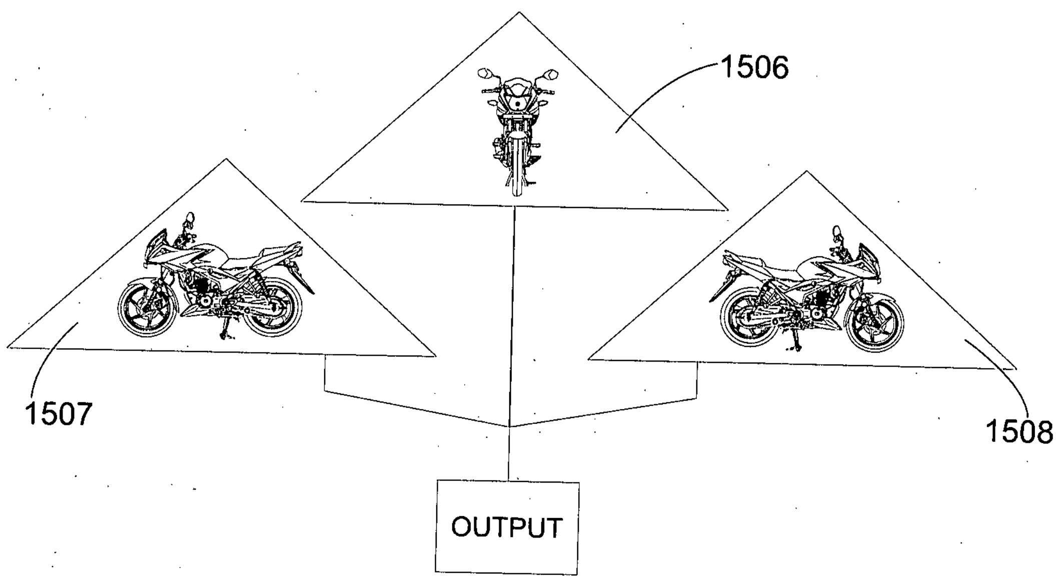
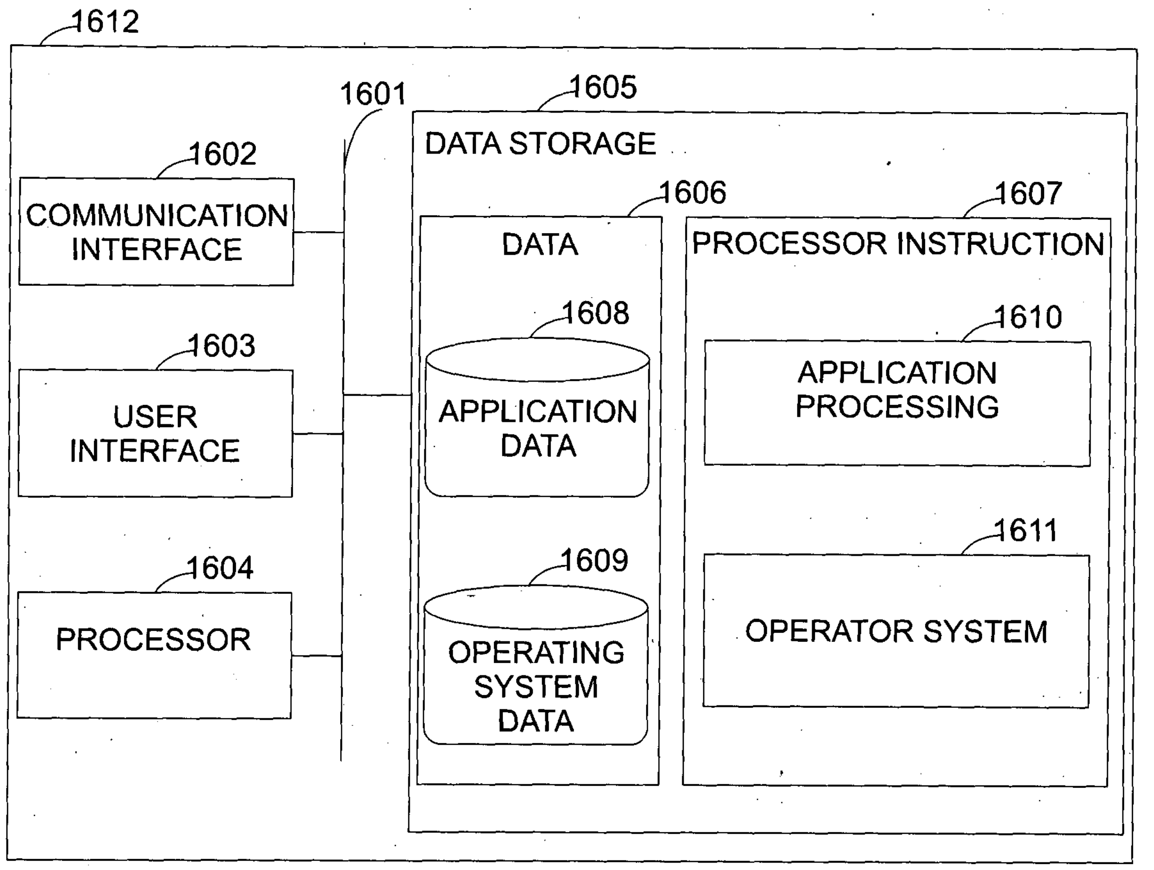



FIG. 15(c)


1612
1601
1605
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1602
COMMUNICATION INTERFACE
1606
DATA
1607
PROCESSOR INSTRUCTION
1608
1603
1610
APPLICATION PROCESSING
USER INTERFACE
APPLICATION DATA
1611
1609
1604
PROCESSOR
OPERATING SYSTEM DATA
OPERATOR SYSTEM

FIG. 16

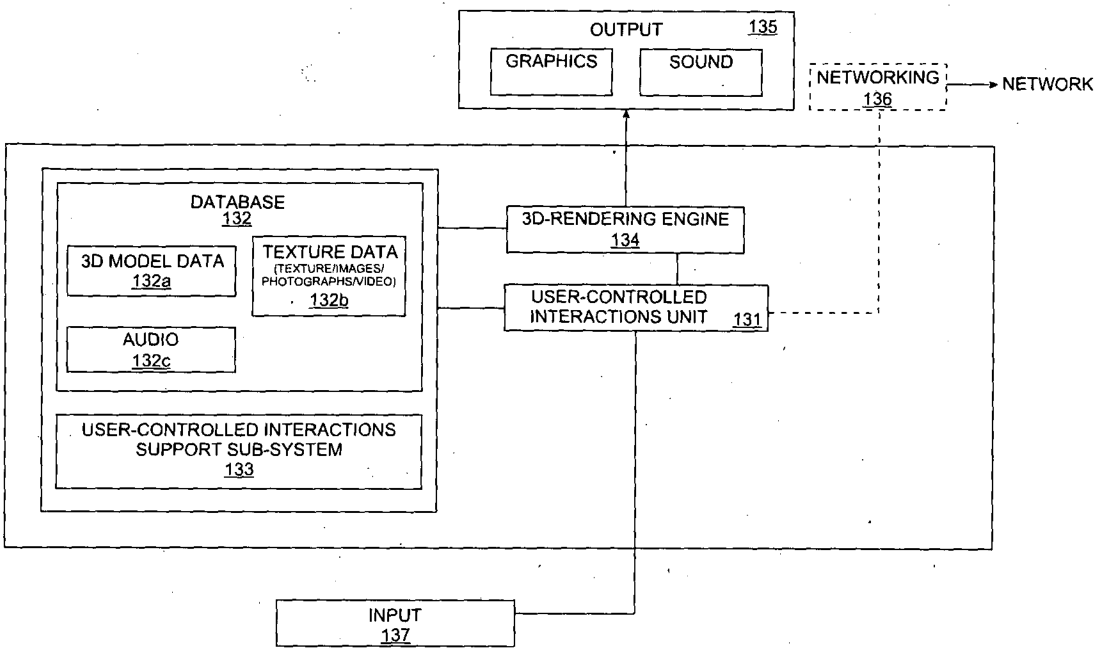


FIG. 17 (a)

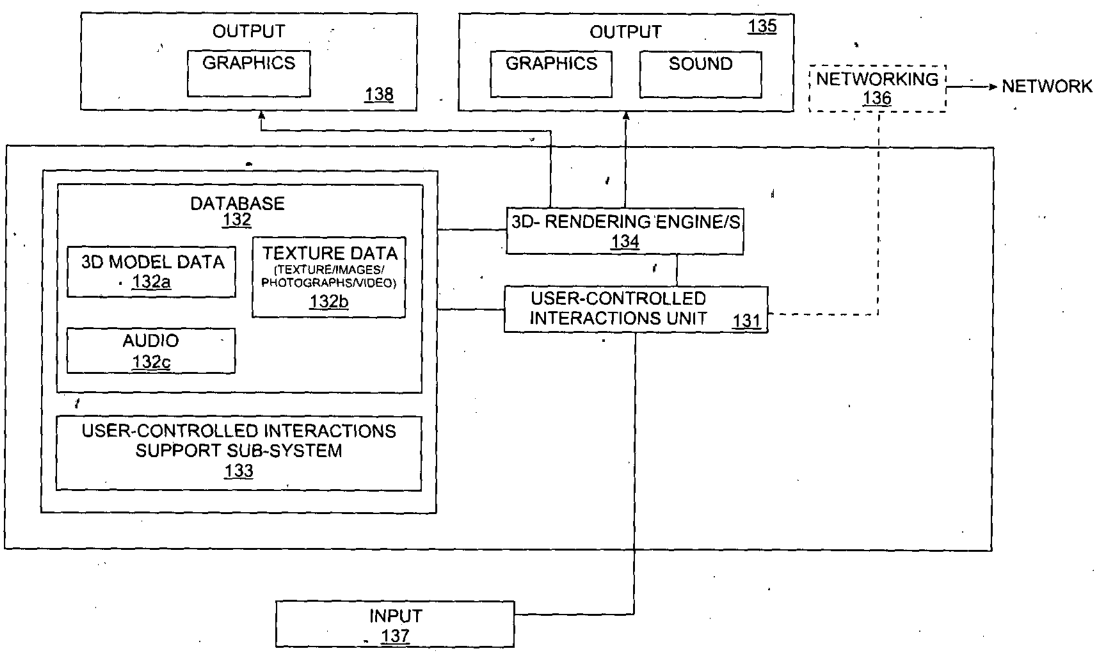


FIG. 17 (b)

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/IN2015/000129

A. CLASSIFICATION OF SUBJECT MATTER
G06T19/00,G06T1/00,H04N5/66 Version=2015.01

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G06T, H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Databases:PatSeer,IPO internal
Keywords: 3D model, visualization, simulation

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X | WO2014006642 A2 (Nitin Vats, Gaurav Vats et al) January 9, 2014 (09-01-2014) (Abstract, Figures 10, 15, 19 Paragraphs 3, 37-71, 88, 95 and 102) | 1-30 |

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 29-06-2015 | 29-06-2015 |

| Name and mailing address of the ISA/ | Authorized officer |
|---|---|
| Indian Patent Office<br>Plot No.32, Sector 14,Dwarka,New Delhi-110075<br>Facsimile No. | Subhash Kumar Singh<br>Telephone No. +91-1125300200 |

International application No.
PCT/IN2015/000129

| Citation | Pub.Date | Family | Pub.Date |
|---|---|---|---|
| WO 2014006642 A2 | 09-01-2014 | US 20140208272 A1 | 24-07-2014 |
| | | CA 2879523 A1 | 09-01-2014 |