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(54) **ENTERTAINMENT SYSTEM FOR A VEHICLE**

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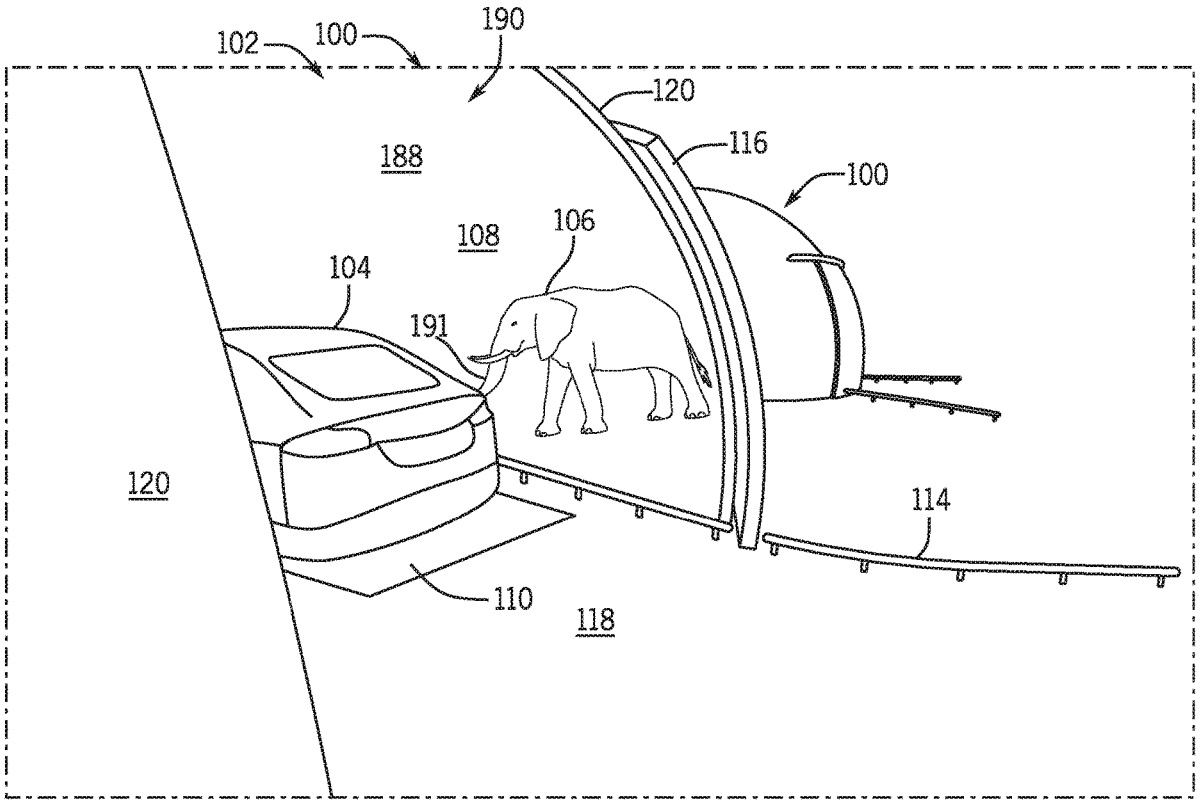
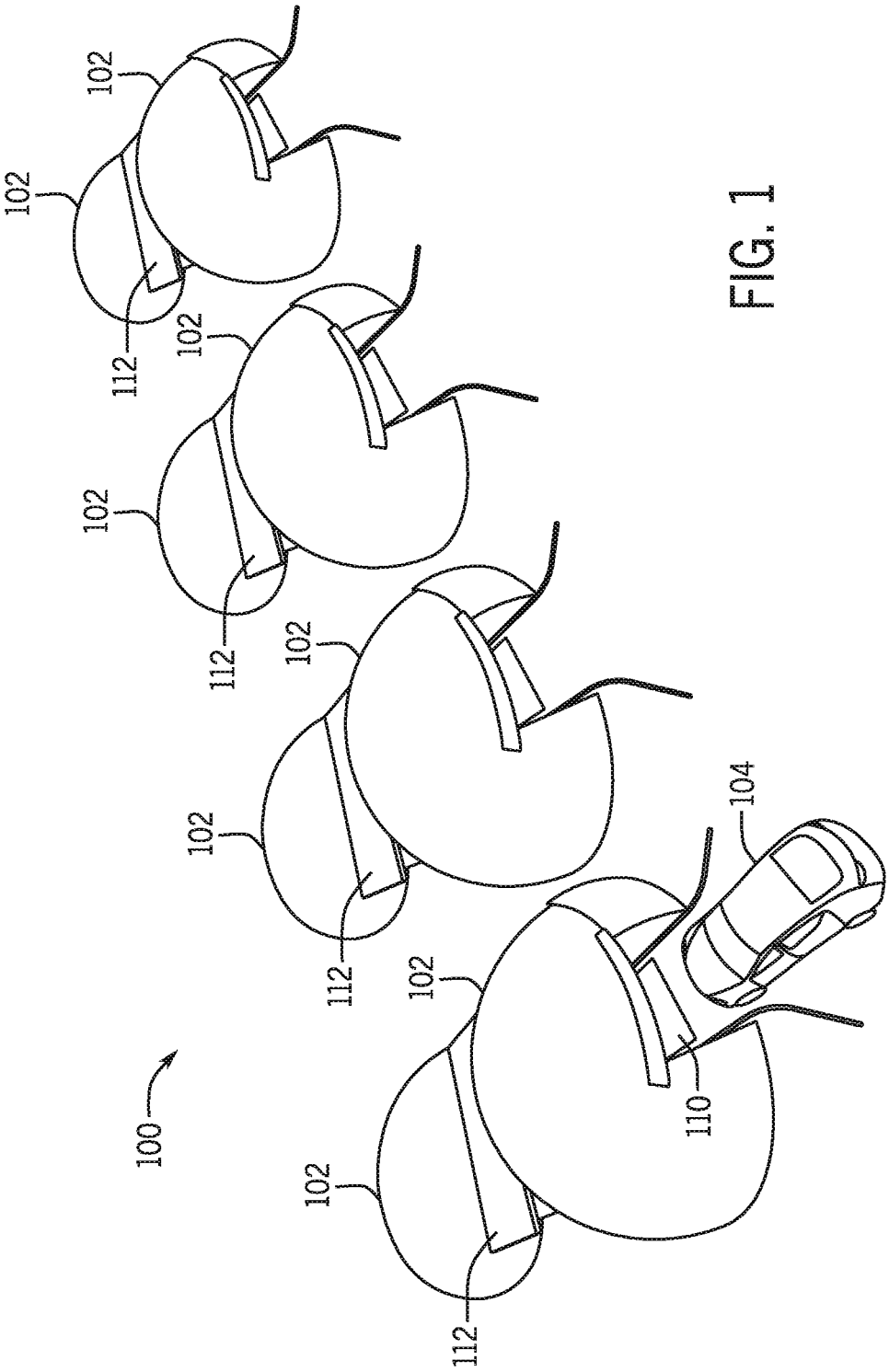
(57) **ABSTRACT**

The present disclosure relates to an entertainment system for a vehicle. In one embodiment, the entertainment system includes a display external to the vehicle and viewable by an occupant of the vehicle. The entertainment system includes a communication module to receive occupant preferences from an occupant, and a processor configured to generate or modify content to be presented on the display based on the occupant preferences.

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112

FIG. 1

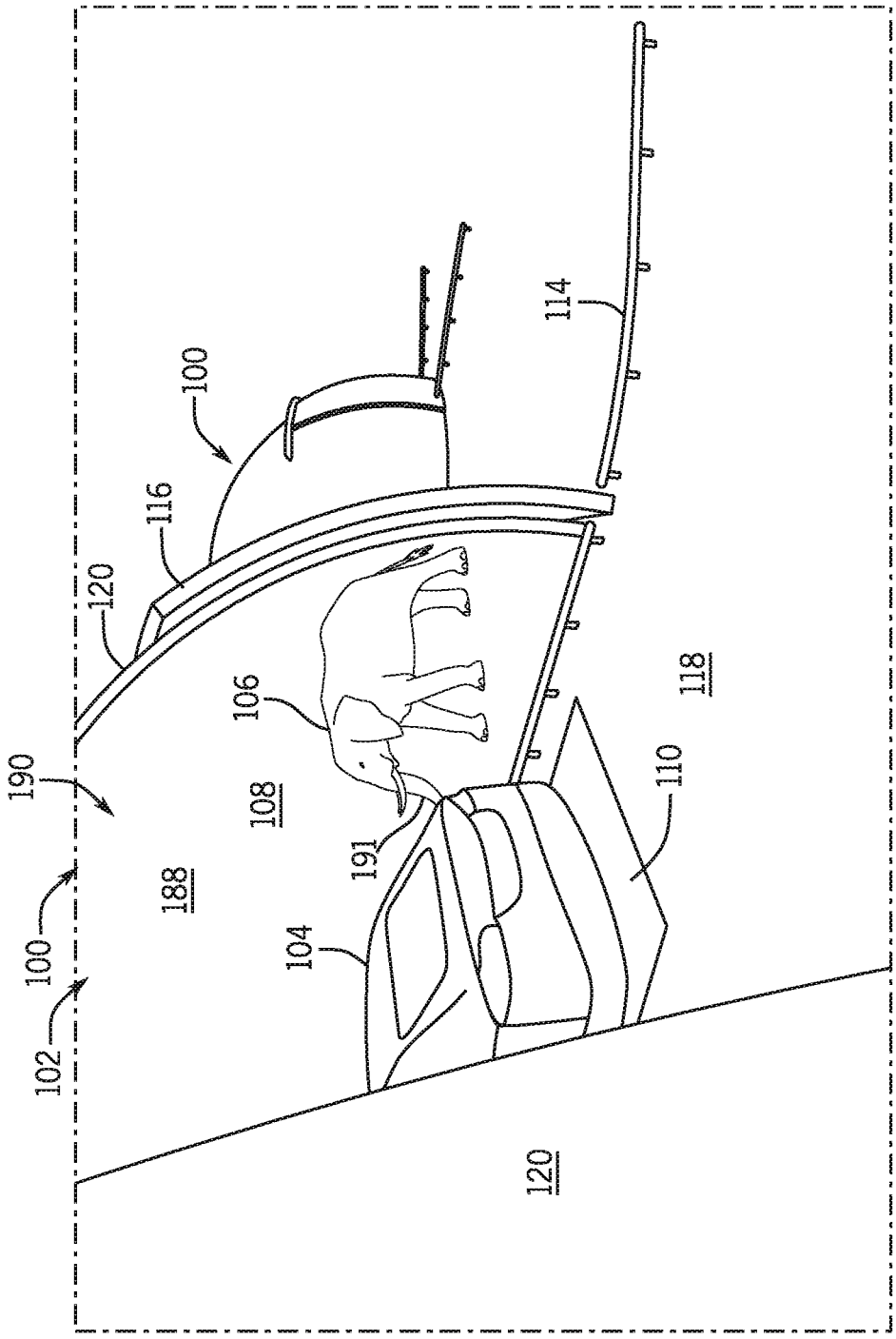


FIG. 2

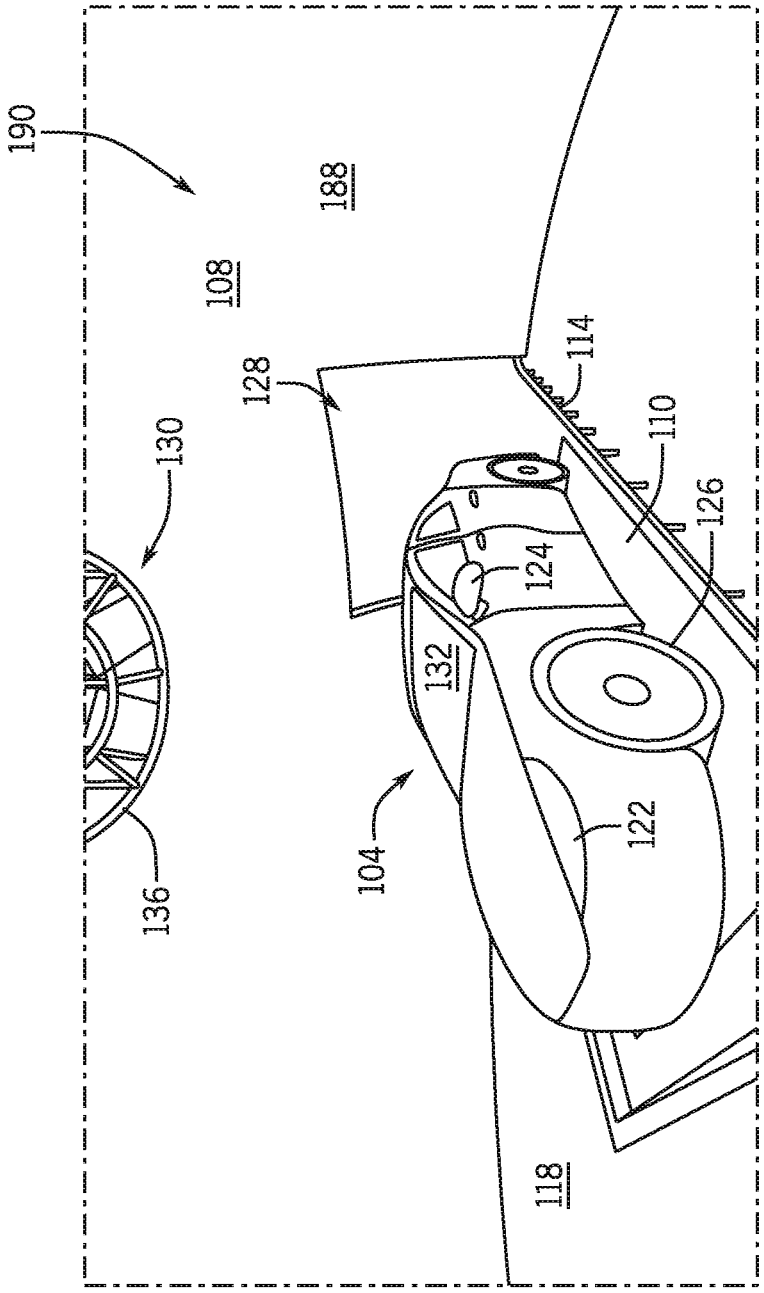
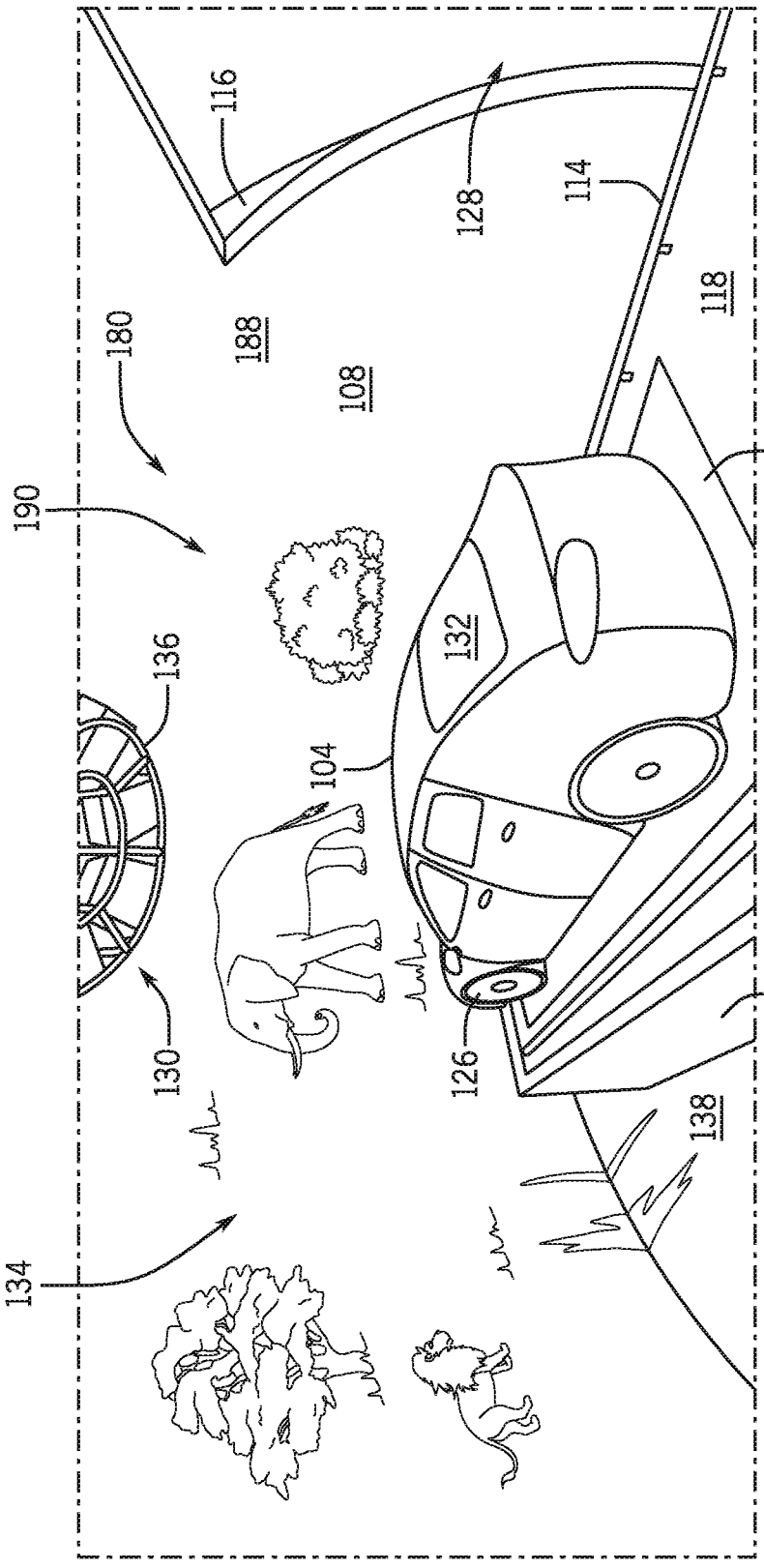


FIG. 3


116
128
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118
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188
108
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190
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136
104
130
126
140
138
134

FIG. 4

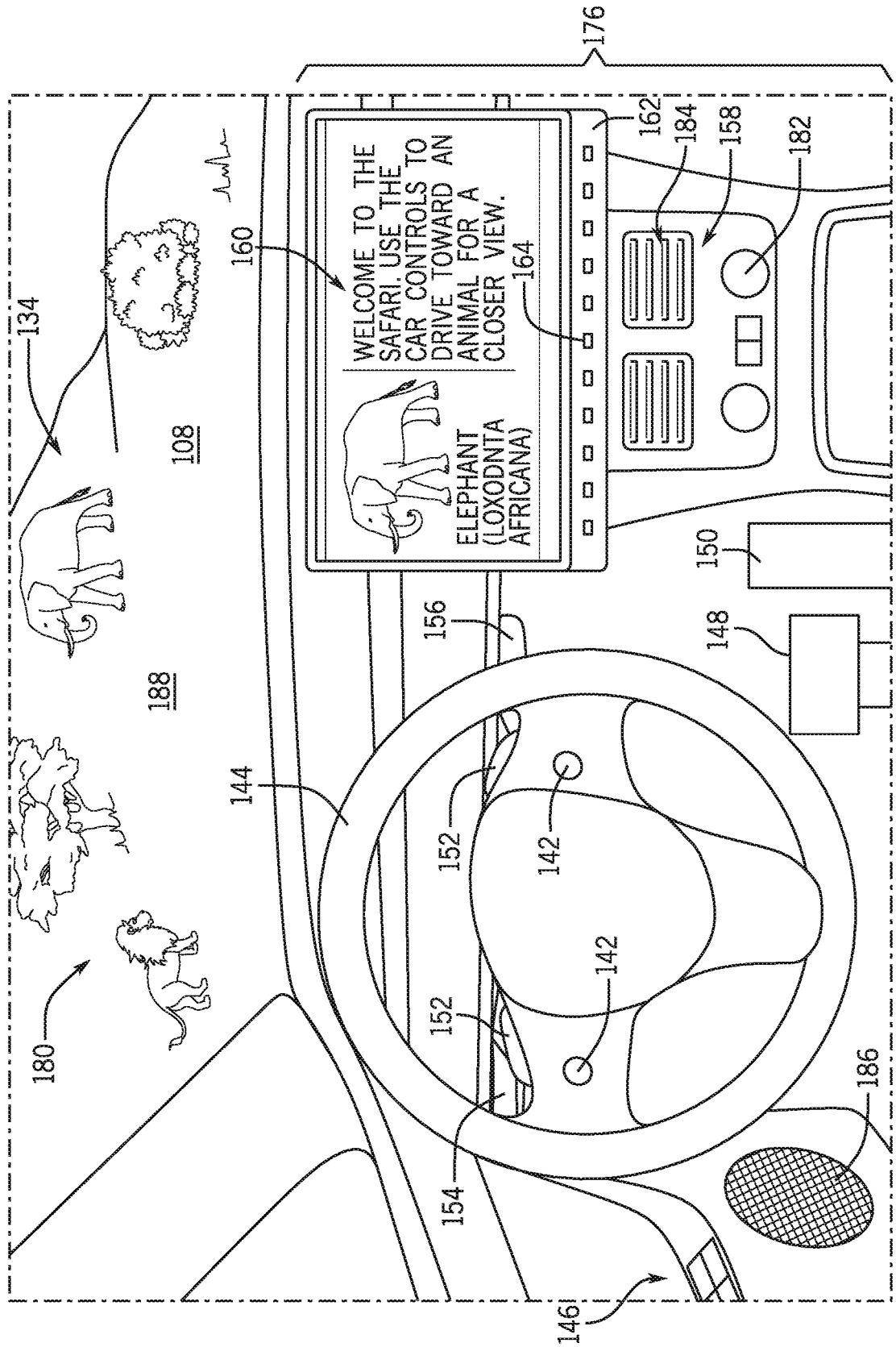
176
162
184
158
182
160
WELCOME TO THE SAFARI. USE THE CAR CONTROLS TO DRIVE TOWARD AN ANIMAL FOR A CLOSER VIEW.
164
ELEPHANT (LOXODNTA AFRICANA)
134
108
188
150
156
148
144
152
142
142
152
154
186
180
146

FIG. 5

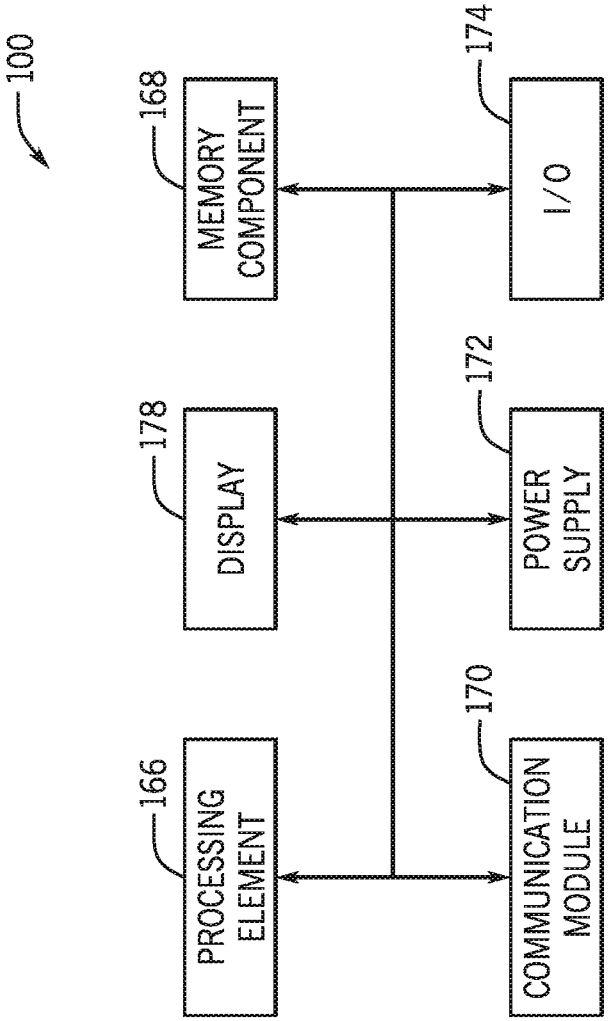
100
168
MEMORY COMPONENT
174
I/O
178
DISPLAY
172
POWER SUPPLY
166
PROCESSING ELEMENT
170
COMMUNICATION MODULE

FIG. 6

ENTERTAINMENT SYSTEM FOR A VEHICLE

TECHNICAL FIELD

[0001] Systems and methods providing entertainment systems for use with a vehicle.

BACKGROUND

[0002] Onboard computing and infotainment capabilities of vehicles have become increasingly sophisticated. Yet the content presented by such systems remains limited to in-dash or other internal screens and audio systems which necessarily limit the immersiveness of the experience. For example, while an in-vehicle infotainment system may play a movie, an occupant need only look out the window and see the real-world outside of the movie breaking the immersion in the media. Further exacerbating the problem, electric vehicles may need long periods of non-driving time to charge. During such times, occupants may find themselves in their vehicles, not driving, and with little to do while the vehicle charges. In some cases, charge times can be on the order of several hours. The problem is not limited to electric vehicles; conventional combustion-driven vehicles may be idle for long periods of time as well (e.g., during service, waiting for meal delivery, etc.). Currently, there is no way to provide immersive entertainment to the occupants of the vehicle during such periods of non-driving time. Improved methods and systems of providing content to vehicle occupants are needed.

BRIEF SUMMARY

[0003] An entertainment system for a vehicle is disclosed. In one embodiment, the entertainment includes a display external to the vehicle and viewable by an occupant of the vehicle; a communication module configured to receive occupant preferences from the occupant; and a processing element configured to generate or modify content to be presented on the display based on the occupant preferences.

[0004] Optionally, in some embodiments, the entertainment system includes a structure configured to receive the vehicle; and a charging device configured to charge the vehicle. The display is coupled to the structure and is configured to present the content to the occupant as the charging device charges the vehicle.

[0005] Optionally, in some embodiments, the display substantially surrounds the vehicle.

[0006] Optionally, in some embodiments, the communication module receives data via a vehicle cable or wireless communication.

[0007] Optionally, in some embodiments, the entertainment system includes a sense effect system configured to provide at least one of a smell effect, a sound effect, a heat effect, a cold effect, a wind effect, or a weather effect.

[0008] Optionally, in some embodiments, the entertainment system includes an animatronic device configured to present a portion of content.

[0009] Optionally, in some embodiments, the animatronic device is configured to electrically couple the charging device to the vehicle.

[0010] Optionally, in some embodiments, the entertainment system includes a base configured to support the vehicle and to provide at least one of a tilt effect, an acceleration effect, a deceleration effect, or a haptic effect to the vehicle.

[0011] Optionally, in some embodiments, the entertainment system includes an auxiliary autonomous vehicle configured to present a portion of the content.

[0012] Optionally, in some embodiments, the auxiliary autonomous vehicle includes at least one of an autonomous aerial vehicle, an autonomous ground-based vehicle, or a robot.

[0013] Optionally, in some embodiments, the entertainment system includes a communication system in electrical communication with a control system of the vehicle. The communication system is configured to transmit a signal to the vehicle, and based on the signal, the control system is configured to present a portion of the content.

[0014] Optionally, in some embodiments, the communication system is configured to activate a portion of the control system in synchronization with the content.

[0015] Optionally, in some embodiments, the control system is configured to receive an input from the occupant, wherein the input causes a change in the content.

[0016] Optionally, in some embodiments, the entertainment system is configured to communicate electronically with an onboard diagnostic II ("OBD-II") interface of the vehicle. In some embodiment, the entertainment system includes an OBD-II device configured to provide the electrical communication between the communication system and the control system.

[0017] Optionally, in some embodiments, the content is configurable by an occupant device.

[0018] Optionally, in some embodiments, the entertainment system the content comprises a game or a puzzle.

[0019] Optionally, in some embodiments, a system includes two or more entertainment systems, where the content comprises a game configured to enable occupants of respective vehicles received in the two or more entertainment systems to participate together.

[0020] In some embodiments, the entertainment system includes one or more processing elements; one or more computer-readable non-transitory storage media, the media encoded with instructions that when executed cause the one or more processing elements to perform operations including: displaying content on a display external to the vehicle and viewable by an occupant of the vehicle; receiving occupant preferences from the occupant; modifying the content based on the occupant preferences; and displaying the modified content.

[0021] A method of providing content to a vehicle is disclosed. In one embodiment, the method includes displaying, via one or more processing elements, content on a display external to the vehicle and viewable by an occupant of the vehicle; receiving, via the one or more processing elements, occupant preferences from the occupant; modifying, via the one or more processing elements, the content based on the occupant preferences to generate modified content; and displaying, via the one or more processing elements, the modified content.

[0022] An entertainment system for a vehicle is disclosed. In one embodiment, the entertainment system includes a display external to the vehicle and viewable by an occupant of the vehicle; a show control system coupled to the display to control content presented on the display, and coupled to an in-vehicle control system to control at least one vehicle

system; and a processing element configured to generate or modify content to be presented on the display to coordinate the content with the at least one vehicle system.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0023] FIG. **1** is a perspective view of an example of a plurality of entertainment systems.

[0024] FIG. **2** is a perspective view of the entertainment system of FIG. **1** including a vehicle entering into the entertainment system.

[0025] FIG. **3** is a perspective view of an example of an interior portion of the entertainment system of FIG. **1** with a vehicle positioned therein.

[0026] FIG. **4** is a perspective view of an example of an interior portion of the entertainment system of FIG. **1** including a vehicle experiencing media content.

[0027] FIG. **5** is an interior view of a portion of an example of a control system of the vehicle in use with the entertainment system of FIG. **1**.

[0028] FIG. **6** illustrates an example of components of the entertainment system of FIG. **1**.

DETAILED DESCRIPTION

[0029] The present disclosure provides for entertainment systems particularly for use with a vehicle such as an on-road passenger vehicle. The disclosed systems, and related methods, include a display external to the vehicle and visible to occupants or users of the vehicle. As used herein, the terms occupants and users are interchangeable. The entertainment systems integrate with the vehicle, such as integrating with a control system and/or operatively coupling to provide control inputs to the control system (e.g., an infotainment system, drive system, climate control system, security system, etc.), to extend the presentation of content to the interior of the vehicle to create an immersive experience. As used herein, content is any kind of visual, auditory, motion, smell, weather, light, heat, cold, or other sensory effect generated by the entertainment system **100**. Relatedly, presentation of content includes, but is not limited to, display of visual information, effects, and/or lighting as well as generation of sounds, smells, motion effects (e.g. haptics, tilt, acceleration, etc.), weather effects, heat or cold effects, or any other sensory effect, etc. The content may include a story telling, narrative, or plot aspect which may be supported or augmented by the sensory effects. For example, a portion of the content may be presented or generated by the external display (e.g., outside of the vehicle), and/or other external systems, and a portion of the content may be presented internal or within the vehicle systems (e.g., inside the vehicle), wherein the internal vehicle presentation may be correlated or connected with the external presentation. The external and internal content elements may be presented in synchronization or otherwise correlated or coordinated with one another. The entertainment system may also include systems to generate content elements, such as effects, e.g., sound, haptics, light, smell, weather effects (e.g., rain, wind, snow, fog, etc.). In some examples, a wind effect may include air moved within the internal compartment **190**, such as by a fan, blower, compressed air source, or the like. In some examples a wind effect may be combined with a cold effect (e.g., a cool breeze after a simulated rain storm) or a heat effect (e.g., a blast of hot air in a desert simulation).

[0030] In one example, the entertainment system may present an interactive simulation where the vehicle temporarily becomes an integral part of the simulation or experience. For example, a passenger car is not usually integrated with an interactive simulation, but may temporarily become a part of a simulation through the entertainment system. Content may be presented on the external display, and information related to the content may be presented on an internal display of the vehicle. The vehicle control system may be configured to receive an input from the vehicle occupant such that the input alters or otherwise impacts the content **134**. For example, the content **134** may change based on one or more user actions or user interactivity. For example, the content may be a game and the vehicle driving controls (e.g., steering wheel, brake pedal, accelerator pedal, etc.) may be used to provide inputs to the game, e.g., act as controls for the user's character within the game. The vehicle's controls may be used to provide feedback to the simulation such that the simulation becomes an interactive experience with the vehicle as an integral part thereof. In other words, the vehicle may act as a feature within the content, act to generate sensory experiences for the user with the content, and/or provide user input to more deeply engage with the content. To facilitate such interactive functionality, the entertainment system and the vehicle may be in communication with one another (using wired, wireless, optical, infrared, sonic and/or other available communication technology). In some examples, the communication between the entertainment system and the vehicle may include an application programming interface ("API") that enables communication between the entertainment system and the vehicle.

[0031] With specific reference to FIG. **1**, an example of an entertainment system **100** is shown. The entertainment system **100** includes a structure **102** suitable to receive a vehicle **104** either partially or fully therein. In many examples, the vehicle **104** is an autonomous or semi-autonomous vehicle, e.g., may include a self-driving feature or functionality. However, some examples of the entertainment system **100** may be suitable for use with traditionally user-driven vehicles. In many examples, the vehicle **104** is an electric vehicle. In some examples, the vehicle **104** is a hybrid or traditional internal combustion powered vehicle. In FIG. **1**, multiple entertainment systems **100** are shown. For example, two or more entertainment systems **100** may be placed close to one another for use with multiple vehicles **104**. For example, two or more entertainment systems **100** may be placed in proximity to one another to form a cluster of entertainment systems **100**, such as to provide entertainment for multiple vehicles.

[0032] With specific reference to FIGS. **2** and **3**, in the example shown, the structure **102** or enclosure is a dome-like structure formed by one or more walls **120**. The internal surface **188** of the walls **120** of the structure **102** may form an internal compartment **190** or entertainment environment within which portions of the content may be presented. The compartment **190** may form an immersive environment in which the vehicle **104** is received and within which portions of the content are presented to be experienced by occupants of the vehicle **104**. In some examples, the structure **102** allows containment of the vehicle **104** in the compartment **190**, control of the sensory experience in the compartment (e.g., sound, lights, weather and the like), and can partially

enclose or substantially enclose the vehicle to have a 360° or other immersive display and experience. The structure **102**, and in particular the high sides and top may help ensure that from any viewing location within the vehicle (e.g., through a sunroof) the experience is not disrupted by the real world. In other examples, the structure **102** may be any other suitable size and/or shape to accept a vehicle **104** or present content **134** to occupants of a vehicle **104**. While the examples of the structures **102** shown are sufficiently large to enclose a vehicle **104**, other structures **102** may be used that can partially enclose a vehicle **104**, or may not enclose the vehicle at all. In some examples, the structure **102** is a collapsible structure that can be quickly deployed to a location and may be redeployed with ease. For example, the structure **102** may have a frame/membrane form similar to a tent. In some examples, the structure **102** is a more durable structure formed of traditional construction materials such as metal, concrete, wood, or the like. In some examples, the entertainment system **100** includes a power supply **172** such as a photovoltaic panel **112** (see, e.g., FIG. **1**) that at least partially provides power to the entertainment system **100** and or the vehicle **104**. Other power supplies **172** such as generators, mains connections, batteries, or the like may be used.

[0033] The structure **102** may include a support surface **118** such as a driveway, track, or floor that enables a vehicle **104** to drive (in the case of an autonomous vehicle) or be driven (in the case of autonomous, semi-autonomous, or traditional human-operated vehicles) through an aperture **128** in the structure **102**. For example, a user may select or purchase content **134** (see, e.g., FIGS. **4** and **5**) from a list of available content and place the vehicle **104** in electronic communication with the entertainment system **100**, and the vehicle **104** may drive itself or be driven into the structure **102**. In some examples, the driver of the vehicle **104** may navigate the vehicle **104** into the structure **102** and the entertainment system **100** may prompt the driver (e.g., visually and/or audibly) when to stop. The support surface **118** may have a stop **114** disposed on a portion of a perimeter thereof. The stop **114** may guide the vehicle **104** into the structure **102** and/or through the aperture **128**. The stop **114** may reduce the ability of a vehicle **104** to move too far into the structure **102**. The stop **114** may reduce the ability of occupants of the vehicle **104** to exit the vehicle **104** and enter portions of the structure **102** with access restrictions. The aperture **128** may be a doorway, tunnel, passage, or the like suitable large to receive the vehicle **104**. The aperture **128** may be selectively closeable such as by a door **116**, screen, or the like to enable an enclosed experience if desired. In the example shown, the door **116** is of a suitable shape such that when closed, the door **116** and the dome structure **102** appear from an occupant of the vehicle **104** to be seamless.

[0034] The support surface **118** may include or be adjacent to a base **110** that supports one or more wheels **126** of the vehicle **104**. The vehicle **104** may be driven onto the base **110** from the support surface **118**. The base **110** may be a static floor, or may be an active surface that can tilt, vibrate, accelerate, decelerate, move, translate (e.g., on a moving belt of sliding carriage), or otherwise apply forces to the vehicle **104**. For example, the base **110** may provide a haptic effect to the vehicle **104** such as rumbling, knocking, jolting, acceleration, deceleration, pitch, roll, heave, spin or the like.

[0035] In some examples, the entertainment system **100** may include a charging device **106**. The charging device **106** may be disguised as a themed prop. See, e.g., FIG. **2**, where the charging device is disguised as an elephant with the cable **191** disguised as the elephant's trunk. The charging device **106** may be any suitable device capable of charging the onboard energy storage of the vehicle **104**, such as an electric vehicle. For example, the charging device **106** may have a cable **191** that can carry power and/or data between the vehicle **104** and the entertainment system **100**. The charging device **106** may provide a communications link between the vehicle **104** and the entertainment system **100** via the cable **191**. In some embodiments, such as where the vehicle is not an electric vehicle, the cable **191** provides a communications link but does not charge the vehicle. The charging device **106** may be any form of Electric Vehicle Supply Equipment ("EVSE") suitable to charge a vehicle **104**. For example, the charging device **106** may be a level 1, level 2, or level 3 (e.g., direct current fast charge) EVSE device as defined for example in the National Electrical Code Handbook (e.g., NEC-1999). Society of Automotive Engineers standard J1772 defines general physical, electrical, communication and performance requirements for EVSE used in North America, and is incorporated herein by reference in the entirety. EVSE standards to other areas than North America are applicable to the charging device **106** as well. In some embodiments, the charging device **106** is a proprietary type of EVSE such as a Tesla® or Rivian® charger, or the like. In some examples, the charging device **106** is an inductive charger disposed on the support surface **118** or the base **110**.

[0036] The charging device **106** may have features that enable it to blend with or supplement the content **134**. For example, the charging device **106** may include features of a character or scenery related to the content **134**. The charging device **106** can have mechanical and/or physical characteristics that allow the charging device **106** to mimic portions of the content. The charging device **106** may also be configured to include dynamic display areas that allow content to be displayed thereon (e.g., a display screen integrated with the charging device **106**). In the example shown in FIG. **2**, the charging device **106** includes features that make it appear to be an elephant and the cable **191** may appear to be its trunk. In some examples, the charging device **106** includes an animatronic character that can present a portion of the content **134**. In some examples, the animatronic character may make a physical electric connection between the charging device **106** and the vehicle **104**, such as plugging in the cable **191**.

[0037] The charging device **106** can provide power to the vehicle **104**, e.g., include a plug or connector that couples to the vehicle and connects the vehicle to a power supply to transfer power therebetween. The charging device **106** may interface between the respective communication modules **170** of the vehicle **104** and the entertainment system **100**, such as via the cable **191**.

[0038] The structure **102** may have a display system **130**. The display system **130** presents a visual component of at least a portion of content **134** (see, e.g., FIG. **4**). The display system **130** may include an external display **108** such as a screen, projection surface (either rear projection or forward projection), scrim, half-mirror film, or the like that displays a visual components of the content **134**. In some examples, the internal surface **188** of the structure **102** may include a projection surface, a display or type of material/color to enable content presentation thereon (either by a projector

136, displays, and/or light sources integrated with the structure 102). In some examples, a substantial portion of the internal surface 188 may include a projection surface. In the example shown, the display system 130 includes one or more projectors 136. The projectors 136 may be disposed on an upper interior portion of the structure 102 such that the projectors 136 can display content 134 on the external display 108 and/or internal surface 188 of the structure 102. In some examples, the projection surface may be retractable and may be deployed when the vehicle 104 is in the appropriate location, such as parked in the structure 102. The external display 108 may be a projection surface such as a reflective screen where the projector 136 is positioned to project light on a front side (e.g., side facing the occupants of the vehicle 104) of the projection surface. In other examples, the external display 108 may be at least partially transparent, translucent or diffusive such that the projector 136 projects a visual component of the content 134 on the rear side of the projection surface (e.g., side facing away from the occupants of the vehicle 104) part of which passes through the external display 108 toward an occupant of the vehicle 104. In other examples, the external display 108 may be a liquid crystal display, light emitting diode display ("LED"), organic LED ("OLED") display, digital light processor, combinations of the same, or the like. In other examples, external display 108 may be transparent such as glass, plastic or film configured as a half-mirror to reflect light from structure 102 or physical props (not shown) illuminated by light from structure 102 in a Pepper's Ghost or similar configuration.

[0039] In the example shown, the projectors 136 may be 2D, stereoscopic or holographic, laser, digital light processor, LCD, LED, or other types of projectors to display the visual portion of the content 134 on the external display 108 in a manner to substantially surround the vehicle 104. For example, the projectors 136 may each display a portion of the visual component of the content 134 such that the portions of the respective projectors 136 tile or overlap to create a seamless visual presentation. Some of projectors 136 may be actuated to move in one or more degrees of freedom under programmatic control so that projected images move across projection surfaces 108 and 118. Further, some light from projectors 136 may be optically coupled via mirrors (not shown) to projection surfaces 108/118 to, for example, hide projectors 136, place projectors 136 in more secure locations, and/or increase the focal length of the projection system to enhance depth effects.

[0040] As shown for example in FIG. 4, the external display 108 may extend below a portion of the vehicle 104. The support surface 118 and the base 110 (if used) may form a platform 140 disposed above a floor 138 of the structure 102. Thus, the display system 130 may display content 134 below the horizon as seen from the point of view of the occupant of the vehicle 104. A benefit of such an arrangement may be more complete immersion of the occupants of the vehicle 104 in the content 134. Another benefit may be that the space between the vehicle 104 and the floor 138 may provide a location for effect generators such as animatronics, lights, weather simulators, or the like to be placed when not in use and out of sight of the vehicle 104 occupants.

[0041] With reference to FIG. 5, an example of a vehicle interior 158 of a vehicle 104 is shown. The vehicle interior 158 shows certain components of the control system 176 of the vehicle 104. The control system 176 may include one or more of an audio system 186, a vehicle light 122 (shown for example in FIG. 2 as an exterior light but may also be an interior vehicle light, not illustrated), a heads-up display on a windshield 132, an internal display 162 such as a touch screen, a windshield wiper control 156, a powertrain, an operator control 142, a steering wheel 144, a window control 146, a mirror 124 control, a moon roof control, a brake control 148, an accelerator 150, a shifter control 152, a vehicle climate control 182, a vehicle infotainment system, a door actuator, a trunk actuator, a seat heater, a seat cooler, a seat massage device, a seat positioner, a clutch, or the like. The control system can control operation, and/or receive input from, these elements.

[0042] FIG. 5 is an example view of the external display 108 from the point of view of an occupant of the vehicle 104. The entertainment system 100 may include any number or combination of effect generators, such as the display system 130, lights, a sense effect system including such devices as air movers, sprayers, scent emitters, motion actuators, haptic actuators, sound generators, animatronics, and/or an auxiliary autonomous vehicle (e.g., an aerial or ground-based drone, robot, or the like), or the like. These can be dispersed within the entertainment environment of the internal compartment 190. In some examples, the content 134 includes an interior portion 160 presented in the vehicle 104 and/or by a portion of the vehicle 104 (e.g., a portion of the control system 176), and an exterior portion 180 presented outside the vehicle 104 by a portion of the entertainment system 100. Correspondingly, the exterior portion 180 of the content 134 may include any combination or number of effects including audio effects, haptic effects, vehicle motion effects, lighting effects, smell effects, weather effects (e.g., heat, cold, wind, rain, snow, fog, or the like). In the example of FIGS. 5 and 6, a visual effect of an exterior portion 180 of the content 134 is viewable on the external display 108 by an occupant of the vehicle 104. The effects generated by the entertainment system 100 may form a cohesive entertainment experience.

[0043] In some examples, a portion of the content 134 may be presented on a virtual reality display, augmented reality display (e.g., a head mounted display or augmented reality glasses) ("AR/VR display"). In some examples, a user using an AR/VR display may see an object or structure of the vehicle (e.g., steering wheel 144), the entertainment system (e.g., a prop), or a portion of the media 134 transform such that one or more properties of the object changes, or the object transforms into some other object. For example, the AR/VR display may present an animation of the steering wheel 144 transforming into a different design, such as a different color/shape for buttons. The AR/VR display may display instructions describing the new function of the button. For example, a button 142 may appear to change from an audio track select button on the steering wheel 144 into a button that causes the entertainment system 100 to display content 134 showing a tranquilizer dart being shot toward a charging lion.

[0044] The entertainment system 100 communicates with the vehicle 104, and vice versa, to present the content 134. For example, the entertainment system 100 may communicate an interior portion 160 of the content 134 to the vehicle 104 for presentation via the control system 176. The activation of the control system 176 for presentation of the interior portion 160 may be synchronized with the exterior portion 180 of the content 134. For example, a visual effect

of the interior portion **160** is displayed on the internal display **162** of the vehicle **104** and may be viewable by an occupant of the vehicle **104**. As with the exterior portion **180** of the content **134**, the interior portion **160** of the content **134** may include any combination or number of effects including audio effects, haptic effects, vehicle motion effects, lighting effects, smell effects, weather effects (e.g., heat, cold, wind, rain, snow, fog, or the like generated by the climate control **182** of the vehicle **104** through one or more vents **184**). The interior portion **160** portion of the content **134** is generally executed by a portion of the control system **176** based on instructions from the entertainment system **100**. The vehicle **104** may communicate with the entertainment system **100** to provide user inputs to the entertainment system **100** configured to affect the content **134**. Thus, a seamless media experience between the entertainment system **100** and the vehicle **104** is presented. The communication between the vehicle **104** and the entertainment system **100** may be transmitted via communication module **170** (discussed in further detail herein). A user input received by the control system **176** may be used by the entertainment system **100** to affect the content **134**. Any portion of the control system **176** may be used for such user inputs, including, but not limited to the window control **146**, brake control **148**, accelerator **150**, turn indicator control **154**, wiper control **156**, etc.

[0045] In one specific example, shown in FIGS. **4** and **5**, the display system **130** displays safari animals, while the sound generator of the entertainment system **100** and/or the audio system **186** of the vehicle **104** plays related animal sounds. The internal display **162** of the vehicle **104** may display an interior portion **160** of the content **134** such as additional information related to an animal displayed on the display system **130**. The internal display **162** may display instructions to the user to prompt the user to interact with the content **134** using the vehicle **104** control system **176**, such as "Welcome to the safari. Use the car controls to drive toward an animal for a closer view." As the user uses the vehicle **104** controls such as the brake control **148**, the accelerator **150**, and/or the steering wheel **144** to drive toward an animal, the base **110** may provide acceleration/deceleration or haptic effects to the vehicle **104**. For example, in response to the user pressing on the accelerator **150**, the control system **176** may send a signal to the entertainment system **100** that the accelerator **150** has been pressed, including the speed and/or depth of the pedal depression. In response to the signal from the vehicle **104**, the base **110** may tilt the vehicle **104** backward to simulate acceleration. Similarly, the base **110** may vibrate to simulate driving over a bumpy road or the bare ground. As the user turns the steering wheel **144**, the vehicle **104** may send signals to the entertainment system **100** indicating the angle, direction, and/or rate of turning of the steering wheel **144** and the display system **130** may pan the content **134** accordingly to simulate left and right turns of the vehicle **104**. Similarly, if the user presses the brake control **148**, the vehicle **104** may send a signal to the entertainment system **100** indicating the speed and/or depth of the brake pedal compression and the entertainment system **100** may cause the base **110** to tilt forward, simulating deceleration of the vehicle **104**. In another example, an animal may appear to charge the vehicle **104** and ram it. The base **110** may transmit haptic vibrations, tilt, raise, or lower the vehicle **104** to simulate the animal ramming the vehicle **104**. As an animal appears to ram the vehicle **104**, the sound system in the vehicle **104** and/or entertainment system **100** may play crashing sounds, activate lights, display a visual effect of on wither the internal display **162**, the external display **108**, or the like.

[0046] In some examples, two or more vehicles **104** may experience a similar content **134** substantially concurrently (e.g., the content **134** may be synchronized between two or more entertainment systems **100**). Thus, the entertainment system **100** may present content **134** with a social or gaming aspect. For example, two or more vehicles **104** in communication with respective entertainment systems **100** may experience content **134** in a form of a multi-player game or puzzle (e.g., escape room) environment, in which the control system **176** of the vehicles **104** take the place of, or supplement, a traditional gaming controller. The respective entertainment systems **100** may be located in proximity to one another, such as in a cluster, or may be distant from one another such as in another part of the country or world. In one example, the occupants of the vehicles **104** may play respective roles in the game environment and the entertainment system **100** may display a representation of one user and/or vehicle (e.g., a digital twin) to another user and/or vehicle. For example, occupants of respective vehicles may be entered into a virtual car race against one another and/or simulated vehicles, and the content **134** may include images of the vehicles **104** passing one another, or projected behind a vehicle **104** such that a competing vehicle appears on the external display **108** and is visible in a rear view mirror. In some examples, the entertainment system **100** may present content **134** and a different entertainment system, such as a gaming console, an occupant device such as a tablet computer, phone, smart watch, fitness tracker, virtual reality display, augmented reality display, or head mounted display, may also present the content **134** substantially concurrently (e.g., synchronized for two or more users inside or outside the vehicle **104**). The different entertainment system may be proximate to the entertainment system **100** (e.g., a user device in the vehicle **104**) or may be distant from the entertainment system **100** (e.g., a gaming console in another country). Continuing the multi-player game example above, the entertainment system **100** may present content **134** simulating a car race, while a gaming console remote from the entertainment system **100** may also present the content **134** car race such that the vehicle **104** occupant and the user of the remote gaming console can both participate in the race. The entertainment systems **100** and/or other entertainment systems may be in communication with one another via the communication module **170** directly or via a network such as the internet, or another network external to the entertainment system **100**.

[0047] In some examples, a duration and/or subject matter of the content **134** is based on a user preference. For example, the entertainment system **100** may present a list of available content **134** from a menu displayed on an occupant device (such as a phone, smart watch, fitness tracker, tablet, laptop, etc.), an internal display **162** of the vehicle **104**, and/or on the external display **108**, and the user may select the content **134** to be presented via one or more of these devices. The menu may be part of a reservation or booking system generated by a processing element that enables a user to reserve the entertainment system **100** for use. Some examples of content available for selection from the menu may include a "charging ride", a long-term event such as a football, soccer, basketball, hockey, or other sports game, or

even an extended stay where the entertainment system **100** offers a natural, relaxing setting including effects such as meteor showers, elephants sleeping, lions on the prowl, etc. Additionally or alternately, the content **134** may be based on an estimated charging time of the vehicle **104** by the charging device **106**. For example, if the charging device **106** estimates that the vehicle **104** will take 2 hours to reach a desired battery state of charge, the entertainment system **100** may select, or offer for selection, content **134** with a duration of about 2 hours. In another example, the entertainment system **100** may select, or offer for selection, content **134** based on a charging time as well as a user preference. For example, if the estimate charging time of the vehicle **104** is 2 hours, and a user would like to have 30 minutes for another activity, such as shopping, the entertainment system **100** may select, or offer for selection, content **134** with a duration of 90 minutes, enabling the user to experience the content **134** and have 30 minutes for shopping. A user may be able to modify the duration of the content **134** at any time before or during the display of the content. In some examples, the entertainment system **100** may modify the content **134** to adapt to the user duration preference or estimated charge time. For example, if a selected content **134** has a duration of 2 hours and the vehicle **104** is estimated to be charged in 90 minutes, the entertainment system **100** may remove scenes from the content **134** or adjust playback speed to fit the time allocated. The content **134** may include suggestions of activities for the user to engage in nearby, but outside the vehicle **104**.

[0048] In some examples, the content **134** may be based on a type of vehicle **104**. For example, the entertainment system **100** may include a sensor such as a camera that acquires an image of the vehicle **104** and a processing element **166** that can determine the type of vehicle **104** from the image. For example, the entertainment system **100** may capture an image of, or scan, a vehicle identification number ("VIN") that identifies one or more aspects of the vehicle, such as the make, model year, etc. The entertainment system **100** may, based on the identified vehicle, determine or retrieve from memory, other aspects of the vehicle such as seat configuration, ride height, wheelbase, number of seats, number of doors, configuration of internal and externa lights, etc. In another example, the vehicle **104** may identify itself via electronic communications with the entertainment system **100**. The content **134** may be adapted for specific kinds of vehicles **104**, including as identified by the entertainment system **100**. The entertainment system **100** may generate bespoke content **134** for a particular vehicle or type of vehicle. For example, if a vehicle **104** that does not enable external control or interface with its control system **176** is used, the content **134** may be limited types of content that do not use features of the control system **176**. Similarly, if a vehicle **104** is of a type that does enable external interfacing with its control system, the content **134** may include the ability to make use of such features. In another example, the content **134** may be adapted based on an estimated or measured user line of sight based on a height of the vehicle **104**. For example, the content **134** may be presented lower on the external display **108** and/or internal surface **188** for a sedan than for a truck.

[0049] In some examples, the entertainment system **100** may offer items for sale to a user via the content **134**. For example, the entertainment system **100** may offer food to be delivered to the vehicle **104**. In some examples, the content **134** may be paused and the vehicle **104** moved away from, or out of, the structure **102** such as to receive a food order, or the like. The vehicle **104** may re-enter the structure **102** and the content **134** may resume. In some examples, the content **134** may be interrupted if the entertainment system **100** detects that a user has exited the vehicle **104** (e.g., either through a sensor such as one or more of: a camera, light detection and ranging (LIDAR), sound navigation and ranging (SONAR), laser, photogrammetric array, or the like) associated with the structure **102**, a microphone that detects a door closure, or a sensor of the control system **176** of the vehicle **104** (e.g., a door ajar sensor). For example, it may be desired to pause the tilting or haptic effects (if used) of the base **110** if a user exits the vehicle **104**. In another example, the entertainment system **100** may offer items for sale that are related to the content **134**, such as a toy, doll, virtual item, or the like. In some examples, an item offered for sale may be authenticated with a non-fungible token, particularly when the item is a virtual item or game content. In some examples, the vehicle **104** may act as a wallet for non-fungible tokens.

[0050] In some examples, the content **134** may be adapted to promote user alertness, such as by presenting a fitness routine for the user to follow. For example, control system **176** and/or entertainment system **100** may include a biometric sensor or internal camera and may be adapted to assess the alertness of a driver. In response to determining that the driver appears to be tired or drowsy, the entertainment system **100** may include user activity prompts (e.g., "Why not get out and stretch?") in the content **134**.

[0051] In some examples, the content **134** may include a virtual concierge configured to assist a vehicle occupant with food ordering, hotel check-in, flight or other travel arrangements. The entertainment system **100** may contact service providers on behalf of the vehicle occupant to request such services.

[0052] In some examples, information may be presented over or with the content **134**. For example, the entertainment system **100** may display a remaining charging time for the vehicle **104** on the external display **108** and/or internal display **162** or may make an announcement over the vehicle **104** or entertainment system **100** sound system. In some examples, the information may be integrated with the content **134** such as by being displayed on virtual signage in the content **134**. The information may be related to a location, planned route, or destination of the vehicle **104**. For example, the information may be localized and include special deals, promotions, points of interest, traffic, waypoints, etc. along a planned vehicle **104** route or destination.

[0053] FIG. **6** illustrates a simplified block diagram for the various devices of the entertainment system **100**, the control system **176**, or other portions of the vehicle **104**. As shown, the various devices may include one or more processing elements **166**, a display **178**, one or more memory components **168**, a communication module **170**, a power supply **172**, and an optional input/output (I/O), where the various components may be in direct or indirect communication with one another, such as via one or more system buses, contract traces, wiring, or via wireless mechanisms.

[0054] The one or more processing elements **166** may be substantially any electronic device capable of processing, receiving, and/or transmitting instructions. For example, the processing elements **166** may be a microprocessor, microcomputer, graphics processing unit, or the like. It also should

be noted that the processing elements **166** may include one or more processing elements or modules that may or may not be in communication with one another. For example, a first processing element **166** may control a first set of components of the computing device and a second processing element **166** may control a second set of components of the computing device where the first and second processing elements may or may not be in communication with each other. Relatedly, the processing elements **166** may be configured to execute one or more instructions in parallel locally, and/or across a network, such as through cloud computing resources.

[0055] In some embodiments, the one or more processing elements **166** may be provided by, or included in, a show control system such as a show controller. For example a show control system may be adapted to link together, synchronize, coordinate, and/or operate multiple control systems, such as the vehicle control system **176**, an interior or external display, a projector, and/or other portions of the entertainment system **100** disclosed herein. The show control system may enable the generation of an integrated media experience from disparate lighting, haptic, sound, and other effect systems. The show control system may present the content based on a show script that includes timing and synchronization signals for the presentation of portions of the media. The show control system may be coupled to either an interior and/or external display to control content presented on the display. The show control system may be coupled to an in-vehicle control system **176** to control at least one vehicle system. A processing element **166** may be configured to generate or modify content to be presented on the display to coordinate the content with at least one vehicle system.

[0056] The display **178** (e.g., the external display **108** used in the display system **130** and/or internal display **162**) provides an input/output mechanism the entertainment system **100** and/or control system **176** such as to display visual information (e.g., images, graphical user interfaces, videos, notifications, and the like) to a user, and in certain instances may also act to receive user input (e.g., via a touch screen, soft controls **164**, or the like). The display **178** may include an LCD screen, plasma screen, LED screen, an OLED screen, reflective and/or diffusive projection surface, projector **136**, or the like. Display **178** may be 2D, stereoscopic, holographic, laser, multiplanar or any display technology suitable for a particular application. The type and number of displays may vary with the type of devices (e.g., the vehicle **104**, the structure **102**, a user device, or the like.)

[0057] The memory component **168** stores electronic data that may be utilized by the computing devices, such as audio files, video files, document files, programming instructions, and the like. The memory component **168** may be, for example, non-volatile storage, a magnetic storage medium, optical storage medium, magneto-optical storage medium, read only memory, random access memory, erasable programmable memory, flash memory, or a combination of one or more types of memory components. In many embodiments, the entertainment system **100** may have a larger memory capacity than the control system **176** of the vehicle **104**, with the memory components optionally linked via network or the like.

[0058] The communication module **170** receives and transmits data to and from the entertainment system **100** and the vehicle **104** and may transmit data to other devices such as other entertainment systems **100**, user devices, gaming consoles, etc. The communication module **170** may transmit and send data directly between the entertainment system **100** and the vehicle **104**, or indirectly such as through a network. For example, the communication module **170** may transmit data to and from the vehicle **104** and/or entertainment system **100** to other computing devices (e.g., other entertainment systems **100**, user devices, gaming consoles, the charging device **106**, the internal display **162**, vehicle infotainment system, a virtual reality or augmented reality display or head-mounted display, etc.). In some embodiments, the communication module **170** may also include various sub-modules, such as an API that interfaces and translates requests between the vehicle **104** and the entertainment system **100**. The communication module **170** may include any suitable wired or wireless interface. For example, the network may be an Ethernet network, Controller Area Network ("CAN") bus, such as defined by Society of Automotive Engineers ("SAE") specification J1939 Wi-Fi, Bluetooth, Wi-Max, Zigbee network, internet of things ("IoT") network (e.g., a 900 MHz network), the internet, microwave link, cellular telephone network (e.g., GSM, GPRS, 4G, 5G, or the like. The communication module **170** may include, or communicate with, an onboard diagnostic II ("OBD-II") device configured to provide the electrical communication between the entertainment system **100** and the vehicle **104** control system **176**. The OBD-II device may be based on at least one of SAE specifications J1962, J1850, J2284 or ISO specifications 9141-2, 14230, or 15765, or similar standards. For example, the communication module **170** may include an OBD-II dongle that plugs into an appropriate port in the vehicle **104** to establish a wired connection to the vehicle **104** control system **176** and also communicates wirelessly (e.g., Wi-Fi) with the entertainment system **100**. In some examples, the communication module **170** may include electronic communication between the vehicle **104** and the entertainment system **100** via a cable connection between the charging device **106** and the vehicle **104** (e.g., via the cable **191**). In some embodiments, the network may include security features such as a firewall or a "walled garden". As used herein, a walled garden refers to an environment that controls the user's access to network-based content and services. The walled garden directs the user's navigation within particular areas to enable access to a selection of material or prevent access to other material. The network security features may limit bad-actors from unauthorized access to the entertainment system and/or the vehicle **104**. In some embodiments, a cloud network such as the internet, may be used and access provided to the entertainment system **100** from outside the "wall" but access to the vehicle **104** may be restricted or connections prevented outside the "wall". In some embodiments, the entertainment system **100** and the vehicle **104** control system **176** may be configured such that while the entertainment system **100** can issue commands to the vehicle **104** control system **176**, the control system may determine whether a command is safe to execute. Such security features may enhance the safety of the entertainment system **100**. For example, while it may be possible for a bad actor to access and disrupt the content, the bad actor may be prevented or thwarted from causing the vehicle to take unsafe actions.

[0059] The various devices of the system may also include a power supply **172** such as the photovoltaic panel **112**. The power supply **172** provides power to various components of

the entertainment system **100** and/or the vehicle **104** (such as power to charge the vehicle **104** batteries via the charging device **106**). The power supply **172** may include one or more rechargeable, disposable, or hardwire sources, e.g., batteries, power cord, AC/DC inverter, DC/DC converter, or the like. Additionally, the power supply **172** may include one or more types of connectors or components that provide different types of power to the entertainment system **100** and/or the vehicle **104**. In some embodiments, the power supply **172** may include a connector (such as a CHAdeMO connector) that provides power to the vehicle **104** may also transmits data to and from the vehicle **104** and/or the entertainment system **100**.

[0060] The input/output interface **174** allows the system devices to receive input from a user and provide output to a user. In some devices, for instance the entertainment system **100**, the input/output interface **174** may be optional. For example, the input/output interface **174** may include a capacitive touch screen, keyboard, mouse, stylus, or the like. The type of devices that interact via the input/output interface **174** may be varied as desired. While it is desirable to repurpose available vehicle components and systems to provide an entertainment experience in accordance with the present invention, in other circumstances it may be desirable to augment the vehicle components and systems with special purpose devices that provide input/output functions that are not readily implemented by the native vehicle systems. For example, speakers, in-car lighting and displays, sensors for gesture recognition and the like might be provided by an augmentation device owned, rented or borrowed by the vehicle owner that couples to I/O interface **174** to provide augmented features.

[0061] The description of certain embodiments included herein is merely exemplary in nature and is in no way intended to limit the scope of the disclosure or its applications or uses. In the included detailed description of embodiments of the present systems and methods, reference is made to the accompanying drawings which form a part hereof, and which are shown by way of illustration specific to embodiments in which the described systems and methods may be practiced. These embodiments are described in sufficient detail to enable those skilled in the art to practice presently disclosed systems and methods, and it is to be understood that other embodiments may be utilized, and that structural and logical changes may be made without departing from the spirit and scope of the disclosure. Moreover, for the purpose of clarity, detailed descriptions of certain features will not be discussed when they would be apparent to those with skill in the art so as not to obscure the description of embodiments of the disclosure. The included detailed description is therefore not to be taken in a limiting sense, and the scope of the disclosure is defined only by the appended claims.

[0062] From the foregoing it will be appreciated that, although specific embodiments of the invention have been described herein for purposes of illustration, various modifications may be made without deviating from the spirit and scope of the invention.

[0063] The particulars shown herein are by way of example and for purposes of illustrative discussion of the preferred embodiments of the present invention only and are presented in the cause of providing what is believed to be the most useful and readily understood description of the principles and conceptual aspects of various embodiments of the invention. In this regard, no attempt is made to show structural details of the invention in more detail than is necessary for the fundamental understanding of the invention, the description taken with the drawings and/or examples making apparent to those skilled in the art how the several forms of the invention may be embodied in practice.

[0064] As used herein and unless otherwise indicated, the terms "a" and "an" are taken to mean "one", "at least one" or "one or more". Unless otherwise required by context, singular terms used herein shall include pluralities and plural terms shall include the singular.

[0065] Unless the context clearly requires otherwise, throughout the description and the claims, the words 'comprise', 'comprising', and the like are to be construed in an inclusive sense as opposed to an exclusive or exhaustive sense; that is to say, in the sense of "including, but not limited to". Words using the singular or plural number also include the plural and singular number, respectively. Additionally, the words "herein," "above," and "below" and words of similar import, when used in this application, shall refer to this application as a whole and not to any particular portions of the application.

[0066] Of course, it is to be appreciated that any one of the examples, embodiments or processes described herein may be combined with one or more other examples, embodiments and/or processes or be separated and/or performed amongst separate devices or device portions in accordance with the present systems, devices and methods.

[0067] Finally, the above discussion is intended to be merely illustrative of the present system and should not be construed as limiting the appended claims to any particular embodiment or group of embodiments. Thus, while the present system has been described in particular detail with reference to exemplary embodiments, it should also be appreciated that numerous modifications and alternative embodiments may be devised by those having ordinary skill in the art without departing from the broader and intended spirit and scope of the present system as set forth in the claims that follow. Accordingly, the specification and drawings are to be regarded in an illustrative manner and are not intended to limit the scope of the appended claims.

What is claimed is:

1. An entertainment system for a vehicle comprising:

a display external to the vehicle and viewable by an occupant of the vehicle;

a communication module configured to receive occupant preferences from the occupant; and

a processing element configured to generate or modify content to be presented on the display based on the occupant preferences.

2. The entertainment system of claim **1**, further comprising:

a structure configured to receive the vehicle; and

a charging device configured to charge the vehicle;

wherein the display is coupled to the structure and is configured to present the content to the occupant as the charging device charges the vehicle.

3. The entertainment system of claim **1**, wherein the display substantially surrounds the vehicle.

4. The entertainment system of claim **1**, wherein the communication module receives data via a vehicle cable or wireless communication.

5. The entertainment system of claim **1**, further comprising a sense effect system configured to provide at least one

of a smell effect, a sound effect, a heat effect, a cold effect, a wind effect, or a weather effect.

6. The entertainment system of claim **1**, further comprising an animatronic device configured to present a portion of content.

7. The entertainment system of claim **6**, wherein the animatronic device is configured to electrically couple the charging device to the vehicle.

8. The entertainment system of claim **1**, further comprising a base configured to support the vehicle and to provide at least one of a tilt effect, an acceleration effect, a deceleration effect, or a haptic effect to the vehicle.

9. The entertainment system of claim **1**, further comprising an auxiliary autonomous vehicle configured to present a portion of the content.

10. The entertainment system of claim **9**, wherein the auxiliary autonomous vehicle comprises at least one of an autonomous aerial vehicle, an autonomous ground-based vehicle, or a robot.

11. The entertainment system of claim **1**, further comprising a communication system in electrical communication with a control system of the vehicle, wherein:

the communication system is configured to transmit a signal to the vehicle, and

based on the signal, the control system is configured to present a portion of the content.

12. The entertainment system of claim **11**, wherein the communication system is configured to activate a portion of the control system in synchronization with the content.

13. The entertainment system of claim **11**, wherein the control system is configured to receive an input from the occupant, wherein the input causes a change in the content.

14. The entertainment system of claim **11**, comprising an onboard diagnostic II ("OBD-II") device configured to provide the electrical communication between the communication system and the control system.

15. The entertainment system of claim **1**, wherein the content is configurable by an occupant device.

16. The entertainment system of claim **1**, wherein the content comprises a game or a puzzle.

17. A system comprising two or more of the entertainment system of claim **17**, wherein the content comprises a game configured to enable occupants of respective vehicles received in the two or more entertainment systems to participate together.

18. An entertainment system for a vehicle comprising:

one or more processing elements;

one or more computer-readable non-transitory storage media, the media encoded with instructions that when executed cause the one or more processing elements to perform operations comprising:

displaying content on a display external to the vehicle and viewable by an occupant of the vehicle;

receiving occupant preferences from the occupant;

modifying the content based on the occupant preferences; and

displaying the modified content.

19. A method of providing content to a vehicle comprising:

displaying, via one or more processing elements, content on a display external to the vehicle and viewable by an occupant of the vehicle;

receiving, via the one or more processing elements, occupant preferences from the occupant;

modifying, via the one or more processing elements, the content based on the occupant preferences to generate modified content; and

displaying, via the one or more processing elements, the modified content.

20. An entertainment system for a vehicle comprising:

a display external to the vehicle and viewable by an occupant of the vehicle;

a show control system coupled to the display to control content presented on the display, and coupled to an in-vehicle control system to control at least one vehicle system; and

a processing element configured to generate or modify content to be presented on the display to coordinate the content with the at least one vehicle system.

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