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Virtual Reality-Based Home Visualization and Interaction

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ABSTRACT

The disclosure describes virtual reality (VR) techniques to create a virtual home for visualizing an appearance and functionality of a home setup. Per the techniques, a home can be visualized in virtual reality before completion or at any later time. The techniques, which can be implemented in a smart home application, enable users to preview furniture, appliances, etc. as placed within their virtual home. The user can virtually place furniture in their homes, examine different furniture placement styles and make an informed decision before making a purchase. The techniques also enable testing smart home device automation behaviors in the virtual home. The use of virtual reality offers an immersive experience by allowing users to interact with a digital environment in three dimensions.

KEYWORDS

- Virtual reality (VR)
- Augmented reality (AR)
- Virtual home
- Smart appliance
- Internet-of-Things (IoT) device
- Architectural rendering
- Home remodeling
- Furniture preview
- 3D preview

BACKGROUND

Setting up physical items in a home requires both time and manual effort. Before such activity, there is usually no opportunity to visualize how the different physical items will appear or function until the setup is finished. While homes have been previously depicted in virtual reality, these representations were crafted manually. This isn't feasible or efficient for the typical homeowner who wishes to have their home digitally modeled in virtual reality, especially for

seamless integration with other services such as previewing furniture purchases or testing smart device automation features.

DESCRIPTION

This disclosure describes the use of a virtual reality (VR) platform to create a virtual home for visualizing the appearance and functionality of home setups before their completion, previewing furniture orders, and testing smart home device automation behaviors. Virtual reality technology provides an immersive 3D experience, permitting a user to engage with a lifelike digital environment that replicates their home.

Per the techniques, a user can visualize a home setup and interact with smart home devices in their environment via a virtual reality platform that is made available via a mobile device, such as a smartphone or tablet, or any other suitable device. The techniques leverage the device camera to obtain a real time view of the user's surroundings.

A user-submitted image containing the blueprints of a home is provided to a virtual reality platform. The image is analyzed using image recognition technology to extract essential information such as room layouts (identifying the positions of bedrooms, kitchens, garage, etc.), room dimensions, and the placement of appliances within the rooms. Based on the analysis, the platform generates an initial, rudimentary three-dimensional (3D) rendering of the user's home. Alternatively, the user can input their home address and the blueprint files can be retrieved from an accessible online resource, e.g., a local government or other authority. .

The virtual reality platform provides an initial 3D rendering to the user, providing a basic representation of their home. To enhance the representation, the user can utilize a smartphone or other camera to capture image data while walking through the home. The data is superimposed onto the 3D rendering, providing a more detailed and accurate depiction.

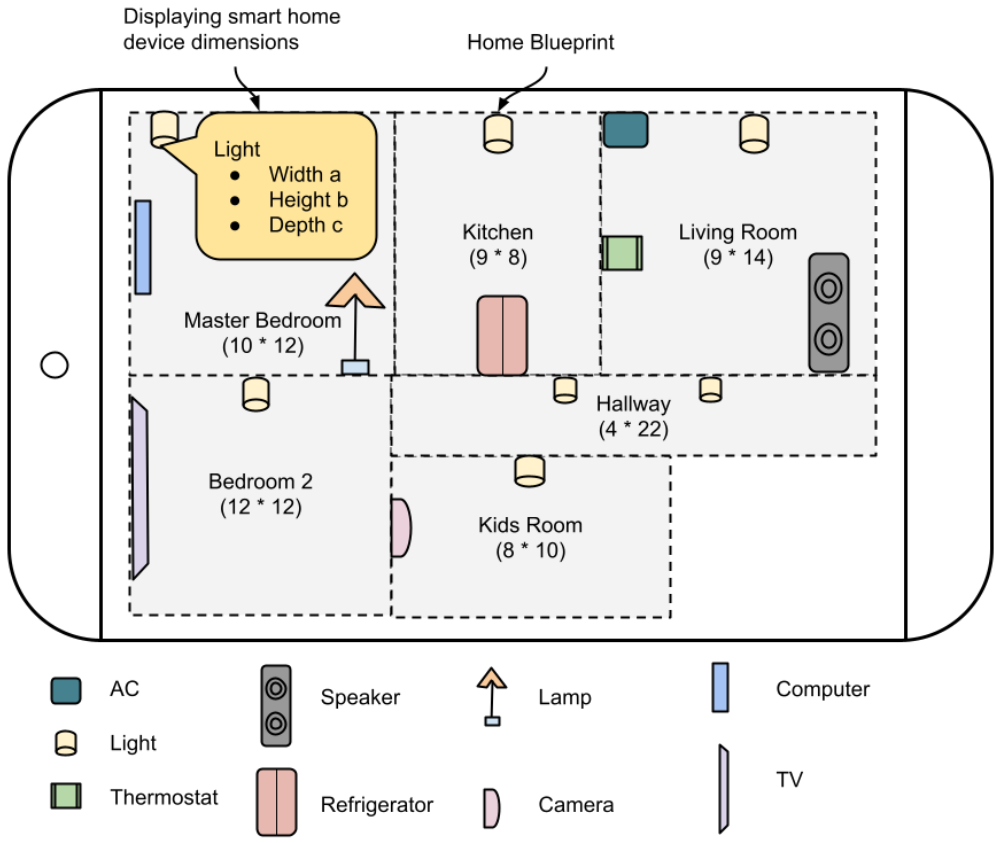

Fig. 1 : A user sees a home representation with 3D rendering. Smart home devices are tagged with approximations for their width, height, and depth measurements in the 3D space.

Fig. 1 illustrates an example home representation that can be used for a 3D rendering, per techniques of this disclosure. Object detection techniques utilize image data captured by the camera to identify objects such as couches, tables, TVs, etc. within the images. The identified objects are tagged, and approximate measurements of their width, height, and depth are obtained. The tagging and measurement process enables the virtual home user interface (UI) to react when the user interacts with objects in the 3D rendering, e.g., enabling the user to reposition these objects within the virtual home. Utilizing the image data, smart home devices that are installed in the home can be identified, e.g., by cross-referencing the images with a list of registered smart home devices provided by the user (e.g., via a smart home management app).

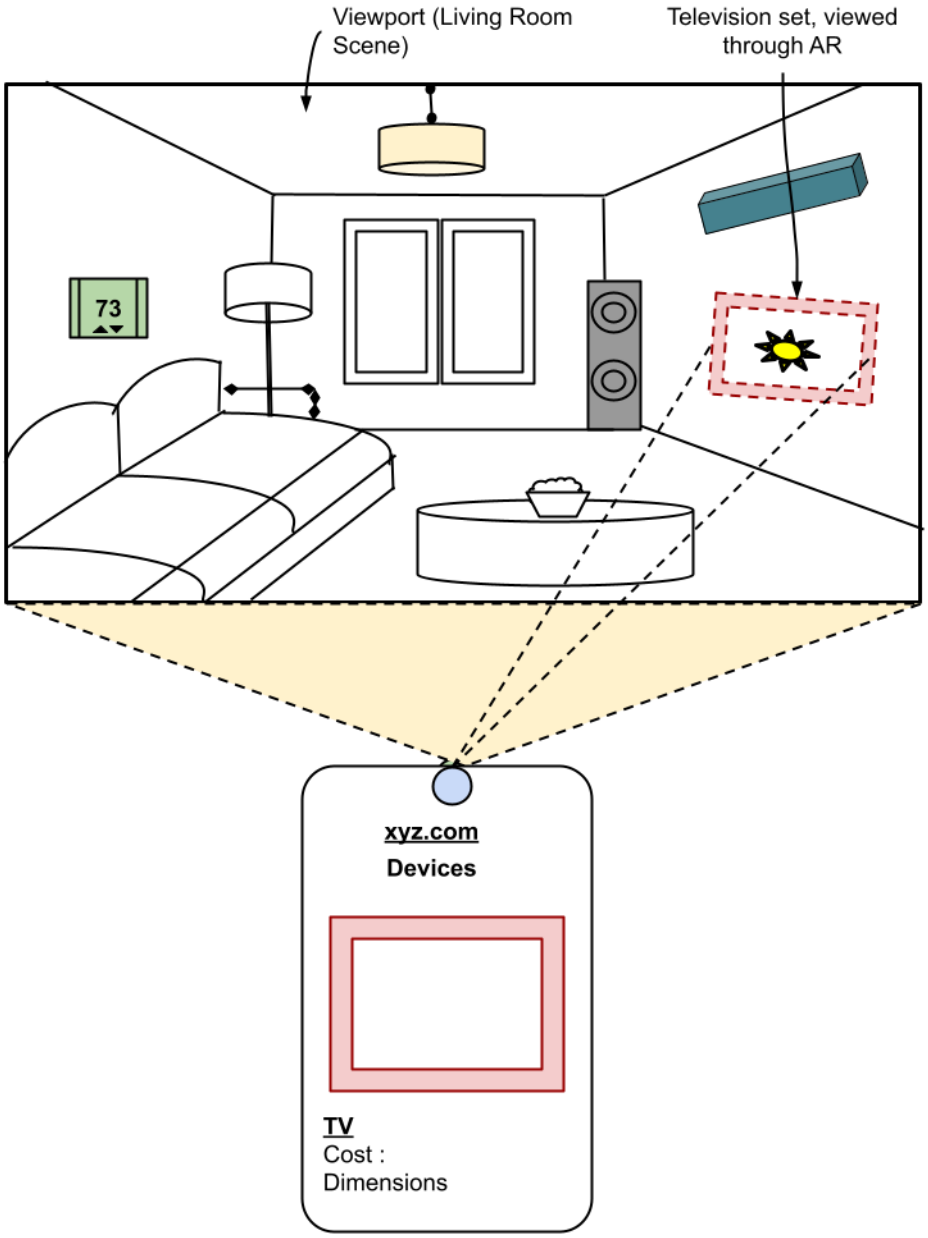

Fig. 2 : A user views their living room through an AR viewport. Detected IoT devices are highlighted. A home furnishing website is displayed.

Fig. 2 illustrates an example living room scene in a home. A user uses a home control app on their smartphone. The app utilizes the camera to obtain a real time view of the living room to establish a virtual equivalent on a VR platform. Once the virtual home is created, the platform provides users with the choice to integrate their virtual home with different home furnishing

websites. The integration allows users to visualize how furniture, appliances, etc. would appear within their home. Additionally, users can also rearrange their existing furniture within the virtual home to accommodate the new items and preview their room.

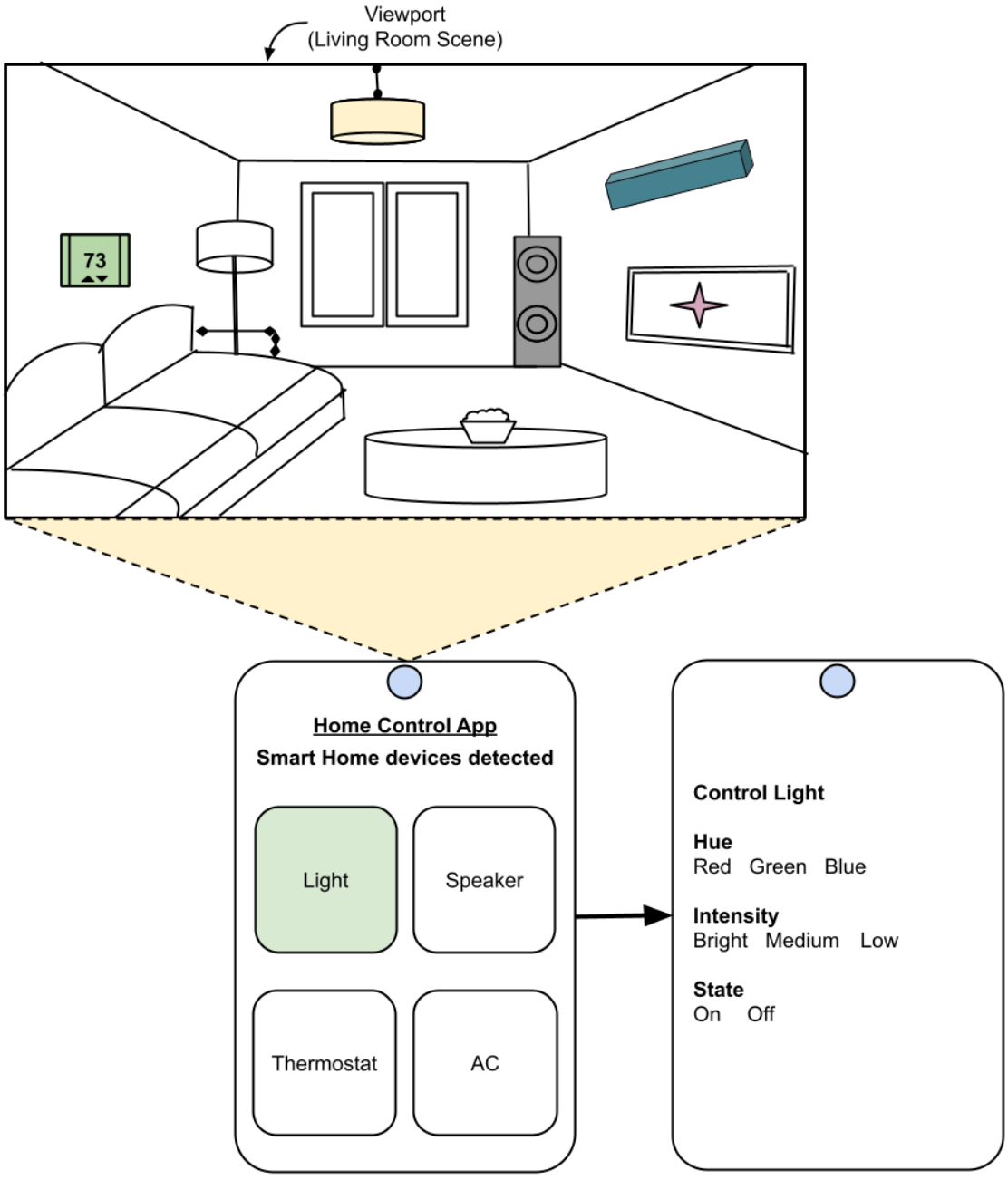

Fig. 3 : A user views their living room through a viewport. Detected IoT devices are highlighted. Control options for the selected device are displayed.

Fig. 3 illustrates an example living room scene in a home. As seen in Fig. 3, IoT devices are placed at different locations within the living room. The user uses a home control app on their smartphone. The app utilizes the camera to obtain a real time view of the living room. IoT devices within the camera viewport are detected from the real time view. The user can tap on any of the identified devices to reveal control options, adjust settings, or perform specific actions for the device. In the example of Fig. 3, upon user selection of the detected smart light, control options for the light - hue, intensity, and state (on/off) - are displayed in the user interface.

The user can configure the app by going to different locations within their home while pointing their camera at their surroundings. As the user does this, suggested device names (e.g., “Hallway light,” “bedroom light,” “bedside light in bedroom #1,” etc. can be provided in the user interface, e.g., displayed on top of the devices detected in the camera view for user confirmation and/or correction.

Users can also use the virtual home to simulate home automation behaviors. For example, if a user creates a home automation using a script editor, e.g., to open the blinds when someone rings the front doorbell, the user can test this automation in 3D by clicking on the front doorbell to ring it and watching the virtual 3D representation of the living room confirm that the blinds open.

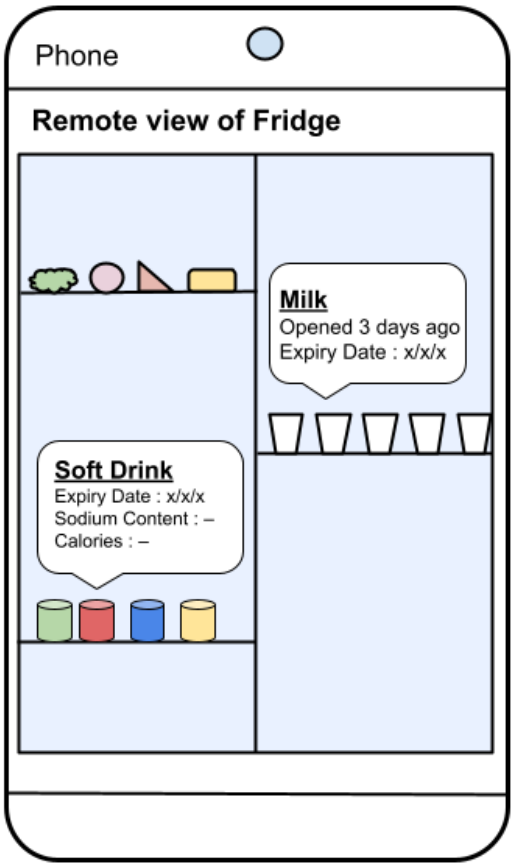

Fig. 4 : Refrigerator interface as seen on a user's smartphone

The installation of smart home devices can enhance the accuracy of the 3D virtual home representation. Fig. 4 illustrates an example refrigerator interface as seen on a user's smartphone. A camera is integrated into the refrigerator and provides an image feed that can be analyzed to recognize various items that are stored. The user can access the 3D virtual home while at work, navigate to the refrigerator, and rearrange items within the virtual representation for a better view. Clicking on the items can allow users access to detailed information, including nutrition facts (e.g., checking the sodium content of a can of soda), expiration dates, and the date an item was opened (e.g., the milk can was opened 3 days ago). Users can also order items for delivery directly through the interface. Similar techniques can be used for other containers or storage

areas within the home, e.g., laundry hampers (e.g., checking the contents of the hamper to identify which clothing items are present), washer and dryer cabinets (e.g., checking the inventory of detergent within the cabinet), etc.

The VR platform as described herein can also provide opportunities to promote smart home devices through the virtual home user interface. For example, while a user is exploring their kitchen in virtual home mode, an icon may appear above the stove, suggesting that the user consider purchasing and installing a smart carbon monoxide monitor there (if one is not currently registered).

Furthermore, the VR platform can enable testing of smart home devices within the virtual home environment by simulating real-life scenarios. For example, if a smart home manufacturer wishes to assess the ability of a smart speaker device to detect the sound of breaking glass, the manufacturer can create a virtual representation of their device and add it to a virtual home. A developer can then simulate breaking of a nearby window within the virtual home, which triggers various signals to nearby virtual devices:

- Audio signals resembling the sound of breaking glass, with adjustments for audio intensity based on proximity and any obstacles in the path.
- Vibration data simulating the impact of glass hitting the floor.
- Changes in air composition to replicate increased ventilation associated with a broken window.

If a security system is installed nearby and designed to detect window breakage, the audio signals from that system going off can also be transmitted to nearby virtual devices. Similarly, this virtual environment facilitates the testing of various behaviors of smart home

devices, including their internet and electricity usage, among other functionalities. For example, simulating day-to-night transitions or changes in weather conditions.

The VR platform can be part of a smart home management application that provides a metaverse or simulated view of a user's home. The virtual home can be created in the app or via a website. Home images and/or other user data are obtained with specific user permission, and for the virtual home functionality described herein.

Further to the descriptions above, a user may be provided with controls allowing the user to make an election as to both if and when systems, programs or features described herein may enable collection of user information (e.g., information about a user's home including home images, furniture, home appliances, smart home devices, etc., a user's preferences, or a user's current location), and if the user is sent content or communications from a server. In addition, certain data may be treated in one or more ways before it is stored or used, so that personally identifiable information is removed. For example, a user's identity may be treated so that no personally identifiable information can be determined for the user, or a user's geographic location may be generalized where location information is obtained (such as to a city, ZIP code, or state level), so that a particular location of a user cannot be determined. Thus, the user may have control over what information is collected about the user, how that information is used, and what information is provided to the user.

CONCLUSION

The disclosure describes virtual reality (VR) techniques to create a virtual home for visualizing an appearance and functionality of a home setup. Per the techniques, a home can be visualized in virtual reality before completion or at any later time. The techniques, which can be implemented in a smart home application, enable users to preview furniture, appliances, etc. as

placed within their virtual home. The user can virtually place furniture in their homes, examine different furniture placement styles and make an informed decision before making a purchase. The techniques also enable testing smart home device automation behaviors in the virtual home. The use of virtual reality offers an immersive experience by allowing users to interact with a digital environment in three dimensions.

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