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Registration and Control of Smart Home Devices via Augmented Reality

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ABSTRACT

Smart home devices can be controlled via a smartphone or other device. However, when a user has several smart home devices in their home, identifying a particular device and accessing its controls can be cumbersome. This disclosure describes the use of augmented reality (AR) to detect and register smart home devices, and to automatically surface device control user interface for devices within a user's view. Per the techniques, object recognition is used to detect the make and model of devices within a user's camera view to enable the user to easily configure the device. Mesh network protocols are used to locate devices within the local network, relative to each other and with respect to the user's smartphone or other device used for control. The user can simply select a device within the camera viewport and access the user interface to control the device.

KEYWORDS

- Home control
- Smart home
- Smart device
- Camera viewport
- Mesh networking
- Object recognition
- Augmented reality (AR)
- Internet of things (IoT)

BACKGROUND

As the number of smart Internet-of-Things (IoT) devices in homes continues to grow, it can be challenging for users to identify which devices are remotely controllable and how to control them effectively. Controlling a smart device often requires multiple taps and trial-and-error attempts to find the right controls for the device. Using a smartphone-based app to control a smart device can require navigating through several screens in a user interface in order to reach

the relevant control screen. For example, if a user wants to adjust the temperature for a smart thermostat, the user needs to open the smartphone home control app, scroll to find and select the particular thermostat, and then adjust the thermostat temperature setting to the desired temperature. As the list of available devices grows, navigating becomes more cumbersome.

Voice control via a virtual assistant or other application (e.g., voice assistant on home speakers) offers a hands-free alternative. However, voice control suffers from discoverability issues. Users providing voice commands are often unsure which commands will work for their devices, resulting in a hit-or-miss experience.

DESCRIPTION

The present disclosure relates to controlling Internet-of-Things (IoT) devices in a home or other setting via augmented reality (AR). Per the techniques, a user can interact with different smart home devices in their environment via augmented reality using a home control app made available via a mobile device, such as a smartphone or tablet. The techniques leverage the camera of the mobile device to obtain a real time view of the user's surroundings. Various devices that are within the camera viewport are detected. A highlight or other visual indicator is overlaid on the IoT devices that are within the viewport that can be controlled remotely or can be set up to be controlled remotely. The user can then select any of the highlighted devices to view the available controls for the selected device.

The user can configure the home control app for the set of IoT devices present in their home through detection via the AR interface and can thereby achieve accurate IoT device detection. The home control app enables the user to identify and classify various types of devices, such as smart speakers, thermostats, smart bulbs, or other connected devices commonly

found in homes or other settings. The device recognition process is performed taking into account the make and model of each detected device within the AR viewport.

Once the devices are identified, the AR interface allows users to interact with the devices directly. The users can tap on an identified device to reveal control options, adjust settings, or perform specific actions associated with the device functionality, e.g., adjusting temperature on a smart thermostat, changing color or brightness of a smart bulb, etc.

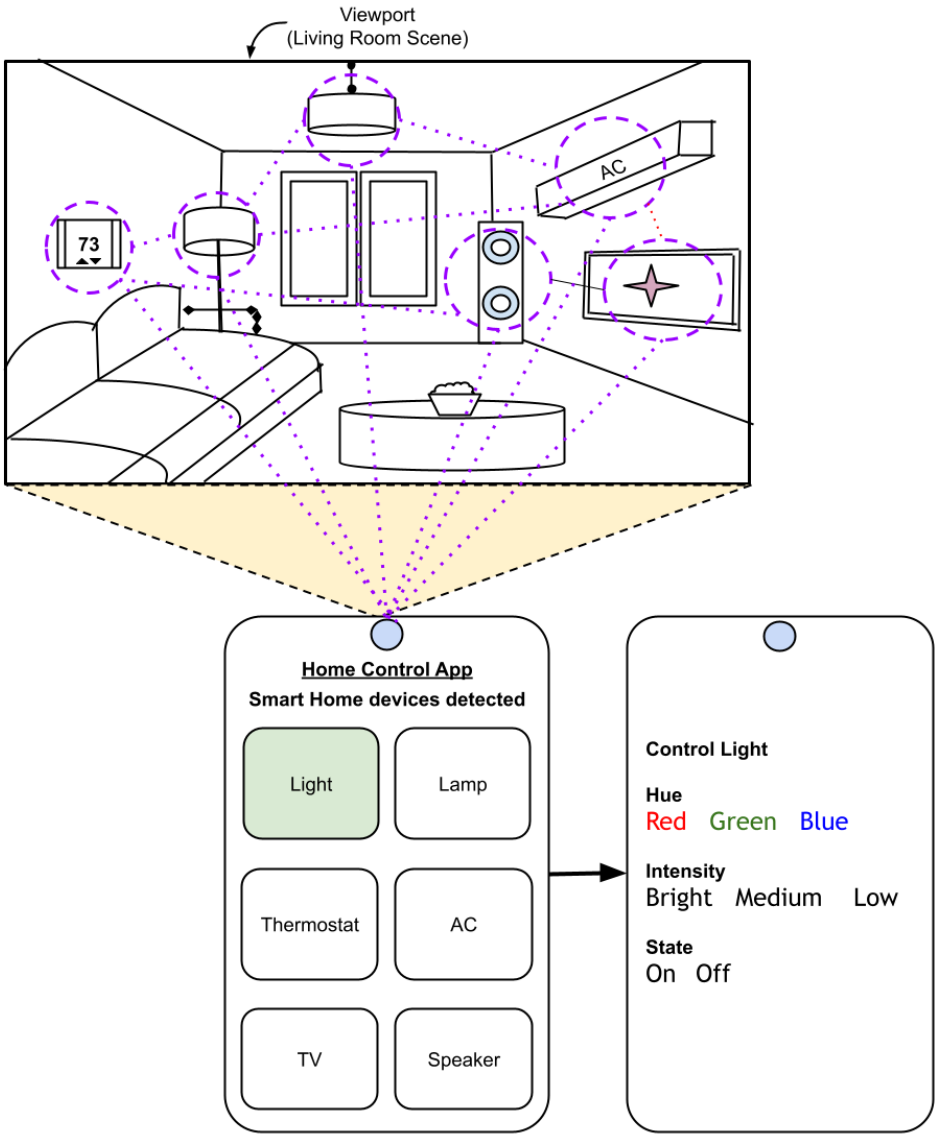

Fig. 1 : A user views their living room through an AR viewport. Detected IoT devices are highlighted in the viewport. The control options for the selected device are displayed.

Fig. 1 illustrates an example living room scene in a home. As seen in Fig. 1, IoT devices are placed at different locations within the living room. 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. Based on the image detected by the camera, the IoT devices within the camera viewport are detected and highlighted in an AR interface. 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. 1, 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 home control app can implement object recognition techniques to detect the various IoT devices within the camera viewport. Object recognition can detect the make and model of each device. A wide variety of smart home devices, e.g., thermostats, TVs, speakers, lights, locks, refrigerators, pool cleaners, curtains, etc. can be detected. With user permission, the home control app can additionally store the contextual image data on the user device and/or in the cloud. This can help determine the location of the different devices within the context of the home.

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 can be provided in the user interface, e.g., on top of the devices detected in the camera view for user confirmation and/or correction.

Based on the object recognition, devices that are controllable are detected and highlighted, e.g., by displaying a border or other visual cue near the detected device. Upon detection of a device, local mesh networking protocols can be used to send a ping to all IoT devices (nodes) within the home, instructing the devices to locate each other. A graph is

constructed using latency in return pings received at each node. The distance between nodes is calculated using ping latency. The orientation of a node can be determined by matching the device graph with the device built-in compass.

During use, a ping is sent from the user device which is used to determine the location of the device in the graph. It is determined if the device is a previously registered device and if so, a control interface is surfaced. If there are no connected devices or if the device is not a recognized device, the user is provided instructions on how to set the device up. The user can interact with device controls via gestures like tapping, swiping, or pinching etc. Based on the detected gestures settings of the device are adjusted.

The described techniques can be implemented as part of any home control app, within a camera app, etc. An application programming interface (API) can also be provided that enables apps to leverage device detection and control techniques 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 smart devices and device configurations, a user's home, 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

This disclosure describes the use of augmented reality (AR) to detect and register smart home devices, and to automatically surface device control user interface for devices within a user's view. Per the techniques, object recognition is used to detect the make and model of devices within a user's camera view to enable the user to easily configure the device. Mesh network protocols are used to locate devices within the local network, relative to each other and with respect to the user's smartphone or other device used for control. The user can simply select a device within the camera viewport and access the user interface to control the device.

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