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Smart-Voice Invocation of Scenes in Home-Automation Systems

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Abstract:

Home environments are rapidly becoming more and more automated via the use of voice-recognizing personal assistants. Home-automation systems using a voice-recognizing personal assistant are capable of configuring smart devices of a home, such as lighting, security systems, or environmental controls, to particular operational settings which, when aggregated across multiple smart devices, constitute a particular scene. Techniques for a home-automation system to configure, or "set", a scene using smart-voice invocation are described.

Keywords: Home automation, voice-recognizing personal assistant, smart home, scene, smart-voice

Background:

Today, with advancements in communication technologies and with computing/sensing electronics embedded in a myriad of devices, the ability for devices to collect and exchange data with one another is escalating. Devices such as smart phones, voice-recognizing personal assistants, computers, automobiles, home entertainment systems/appliances, and the like, are able to communicate with one another either directly, in a machine-to-machine environment, or indirectly over a network. Such communications and exchange of data across the myriad of devices is commonly referred to as the Internet-of-Things (IoT). The communications and exchange of data can have purposes that include, for example, monitoring a person's health, collecting usage data for vendor analytics, remotely initiating/shutting-down of an operating system, automating a home environment, and so forth.

A view of an example IoT environment is represented in Fig. 1 below:

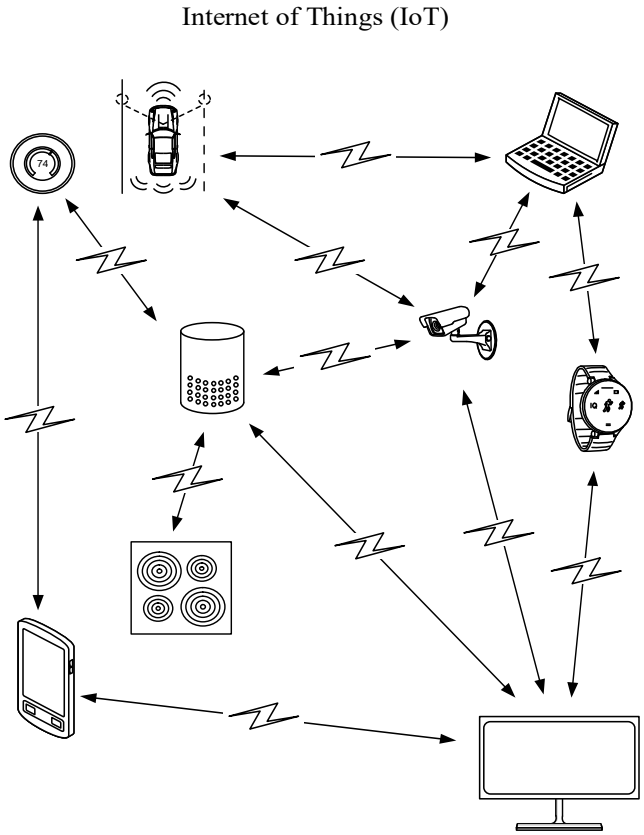

Fig. 1

In the IoT environment of Fig. 1, data may be collected by sensors of a device and shared with another device. Processing of data may be performed locally to the device collecting the data or remotely from the device collecting the data. Combinations of hardware (*e.g.*, sensors, microprocessors, memory), software (*e.g.,* algorithms, GUI's), and services (*e.g.*, communication networks) may be used to sense, collect, and exchange data. Large amounts of data are expected to be exchanged, as part of the IoT, across a horizon that is developing and changing frequently.

A particular aspect of the IoT environment is directed to home-automation systems that configure settings of a home's smart devices, such as lighting, security systems, or environmental controls. In order to avoid a lengthy series of actions directed to configuring each device on an

individual basis, a group of settings is often saved by a home-automation system as a "scene". In an instance where a user is providing home automation instructions via a voice-recognizing personal assistant, the user may forget a name of a desired scene that has been saved and, as a result, not be able to invoke the desired scene without a trial-and-error approach or extended queries to the voice-recognizing personal assistant. Improvements are needed, in home-automation systems, to allow a user to invoke a desired scene.

Description:

A voice-recognizing personal assistant can often be used as part of a home-automation system. As depicted in Fig. 2 below, a user is providing an audible command to a voice-recognizing personal assistant, which in turn, is communicating with a variety of smart devices and managing settings of the smart devices. In certain instances, communication with the smart devices may be direct, using Bluetooth, a local area network (LAN), or the like. In other instances, communication with the smart devices may be indirect, such as an instance where a wi-fi router is serving as an intermediary between the voice-recognizing personal assistant, a cloud-based home automation service, and the smart devices.

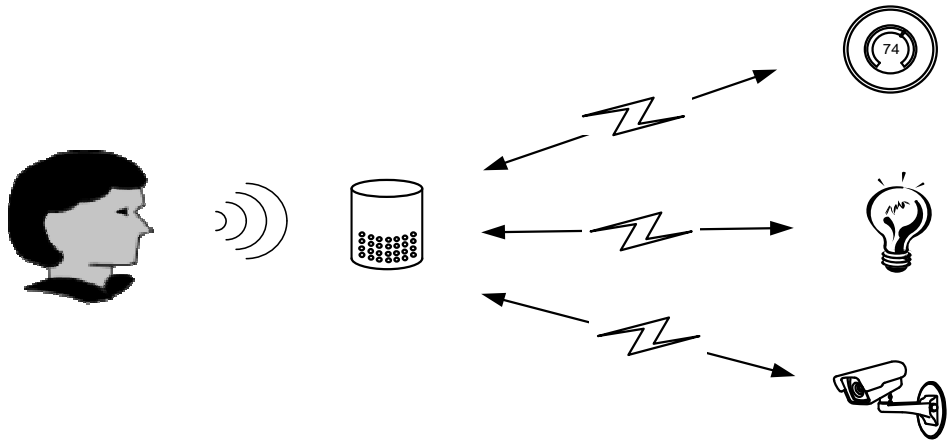

Fig. 2

The voice-recognizing personal assistant may be a stand-alone dedicated system or may be integrated into another system with voice detecting capabilities, such as a smart phone or a smart watch. The smart devices may be any device with connectivity and basic processing capabilities, such as a home environmental control system, lighting, a security system, a home entertainment systems, a kitchen appliance, or the like.

A group of settings for smart devices, constituting a scene, may be invoked via the voice-recognizing personal assistant. In one aspect, the settings may be saved by a cloud-based automation service that is remote from the voice-recognizing personal assistant, while in other aspects the settings may be saved directly on the voice-recognizing personal assistant device. The saved settings may be invoked when the voice-recognizing personal assistant receives and recognizes an audible command directed to setting a scene. For example, if the voice-recognizing personal assistant receives a command such as “personal assistant, please set the party scene”, settings may be communicated to smart devices effective to activate ambient lighting in a kitchen, turn on an entertainment system, and turn on porch lights. As another example, the voice-recognizing personal assistant may receive the command “personal assistant, good-night”, after which a scene is set that turns down lights in the house, turns a thermostat down, and activates a security system.

When setting up a home-automation system, a user may use an application programming interface (API) to setup of the home-automation system. This can include creating identities for smart devices available for automation, identify locations of the smart devices within a house, and associate specific settings of the smart devices to specific scene names.

Improvements to home-automation systems can be achieved using a variety of techniques. In particular, techniques relying on machine learning can be applied to a home-automation system to enable smart-voice invocation and improve a user's ability to invoke a desired scene.

For example, during setup of the home-automation system, a voice-recognizing personal assistant may first ask a user to repeat several phrases so that a user voice pattern might be created. Such a voice pattern can enable identification of the user and association of scenes to the user by the home-automation system.

The home-automation system can then develop a predictive model that can be used to assist a user in selecting scenes. Illustrated in Fig. 3 below are steps of an example method used to develop such a predictive model. As illustrated, after a scene selection has been received and set, the home automation system records context information, such as an identity of a user, a date and time, a room from where the command is being issued (different voice-recognizing personal assistants may be located in different rooms throughout a house), and so forth.

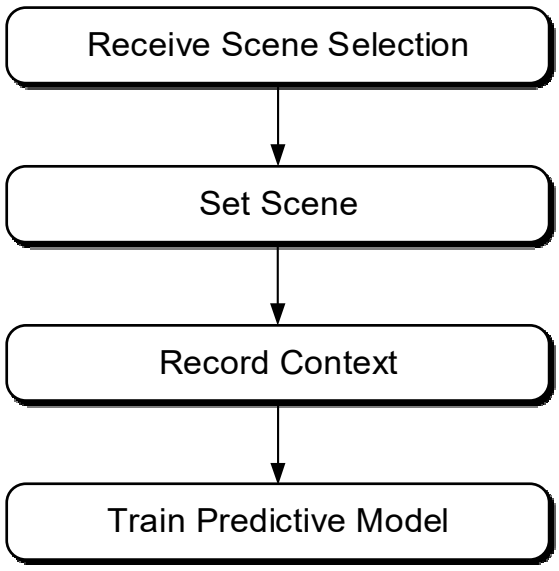

Fig. 3

The trained predictive model can be applied to a variety of circumstances. For example, consider an instance where a user may not remember the name of a particular scene he wishes to have set by the home-automation system. He may, for example, wish to go to bed but not remember if the name of the scene is “good-night”, “nighty-night”, “let’s turn in”, or something else. In this instance, he may merely make a statement such as “personal assistant, please set the scene”. Upon receiving the command, the home-automation system may recognize that the user is in his bedroom and that it is 10:00PM and, based upon the trained predictive model, determine that the most-likely scene is the “good-night” scene and ask the user via the voice-recognizing personal assistant “shall I set the good-night scene?” If confirmation were received from the user, the home automation system then turns down lights in the house, reduces a temperature setting of a thermostat, and activates a security system. This example method of setting a scene based on a proposed most-likely scene, which is performed by the home-automation system, is illustrated in Fig. 4 below:

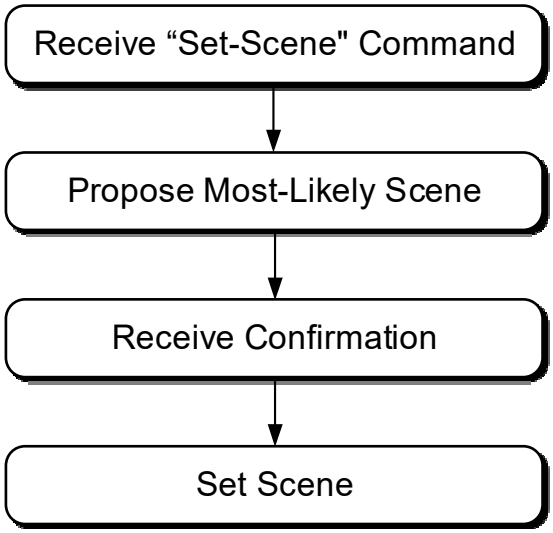

Fig. 4

Under another example circumstance, if multiple scenes appear to be similarly likely to the trained model, the home-automation system may propose multiple options for the user to select. Based on a scenario similar to the one above, upon receipt of the generic statement "personal-assistant, please set the scene", the home automation system may propose several most-likely scene options based on the trained predictive model. In such a case, the home automation system might query via the voice-recognizing personal assistant: "shall I set the good-night scene or set the watch late-night TV scene?" After receiving a user response that indicates the user's selection from the proposed options, the home automation system would then set the scene. This example method of setting a scene based on a selection received after proposing most-likely scene options, which is performed by the home-automation system, is illustrated in Fig. 5 below:

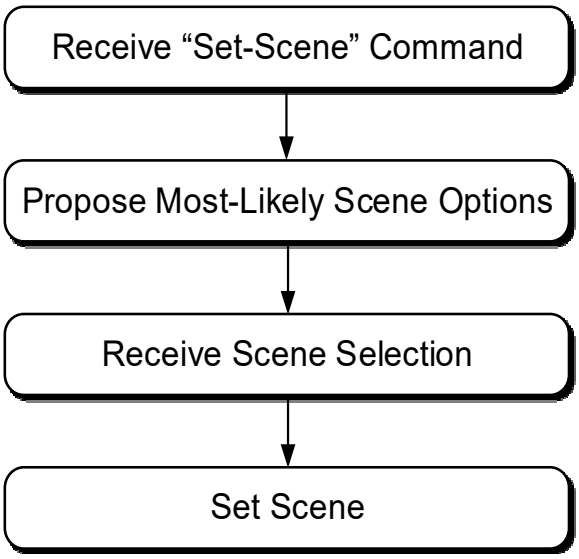

Fig. 5

Another variation includes offering a user additional scene options if the most-likely scene options (as initially proposed) do not meet the user's needs. For example, and continuing with the scenario described above, a user may respond to the initially proposed most-likely scene options,

e.g., "shall I set the good-night scene or set the watch late-night TV scene?" with a request for additional options. The home-automation system then makes another proposal with one or more additional options in order of probability as determined by the trained predictive model. For example, the home-automation system might at this point respond with "shall I set the poker game scene?" after which the user may make his selection. This example method, including an optional path where more scene options are requested and as performed by the home-automation system, is illustrated in Fig. 6 below:

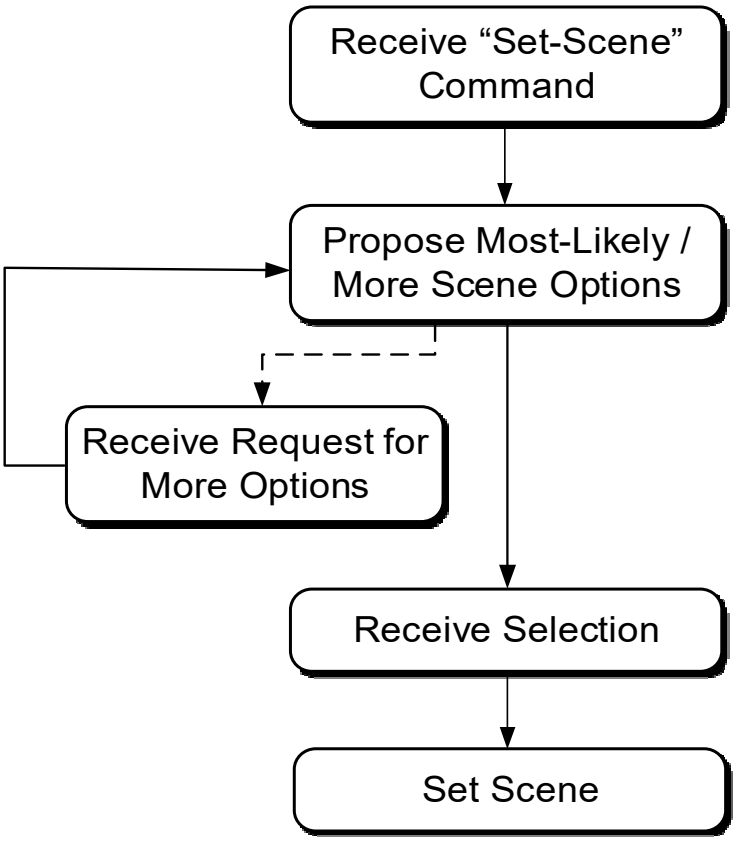

Fig. 6

As home-automation systems evolve and the number of smart devices in a home proliferates, permutations of methods, as well as tools or systems used as part of smart-

voice scene invocation, will continue. With the assistance of machine learning and predictive models, techniques for scene setting can, for example, include techniques that are gesture, activity, or recognition-based. In such instances, tools and systems such as cameras and/or radars may be used to augment or replace activities of the voice-recognizing personal assistant.