

Indoor and Remote Controls and Management of Home Appliances by a Smartphone with a Four-quadrant User Interface

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Abstract--This paper proposes a design both for indoor and remote controls and for management of home appliances by a smartphone by utilizing a four-quadrant user interface. This design features the use of a low power Bluetooth to connect indoor home appliances. A mobile Internet is used to connect home appliances to a smartphone at the remote-side mode. For home appliance management, this design not only measures but also monitors the power consumption of the home appliances. For the user interface, this design uses the Bluetooth allocation function to display the exact position of home appliances at home and combines with a four-quadrant user interface of a smartphone to provide a more user-friendly operation.

I. INTRODUCTION

A previous design uses Bluetooth to connect home appliances to a smartphone as a controller [1]. Another design uses a mobile Internet to connect the home appliances by means of a home server which is then connected to a smartphone [2]. These two previous research projects, which emphasize one single purpose of either controlling or management, instead of multiple purposes, also contain a complicated user interface and rely on a higher power consumption of the Internet connection. Hence, the next home appliance control should include both indoor and remote control and management with a simpler user interface of a smartphone and a lower connection power consumption.

This design consists of two possible connection modes: 1. Indoor mode: When a user is within the range of a Bluetooth connection, home appliances can be connected to a smartphone with a low power Bluetooth. 2. Remote-side mode: When a user is out of the range of a Bluetooth connection, a smartphone connects to an embedded home server through a mobile Internet, and then connects to the home appliances by means of a low power Bluetooth connection. As for the remote controlling and management, this design utilizes the Bluetooth allocation function to display the position of home appliances on a floor plan and combines with the four-quadrant user interface to provide users with a friendly operation.

II. SYSTEM ARCHITECTURE

Fig. 1 shows this design's system architecture which consists of two modes: Indoor mode and Remote-side mode.

A. Indoor mode

When a user is within the range of a low power Bluetooth connection, this design uses Bluetooth to connect a smartphone to home appliances as slaves. In addition, with respect to management, this design measures and monitors the power consumption of home appliances from voltage and current by collecting information from sensors, which is then displayed on a smartphone.

B. Remote-side mode

This design automatically switches to the remote-site mode when the smartphone is out of the indoor Bluetooth connection range. In this mode, the smartphone then connects

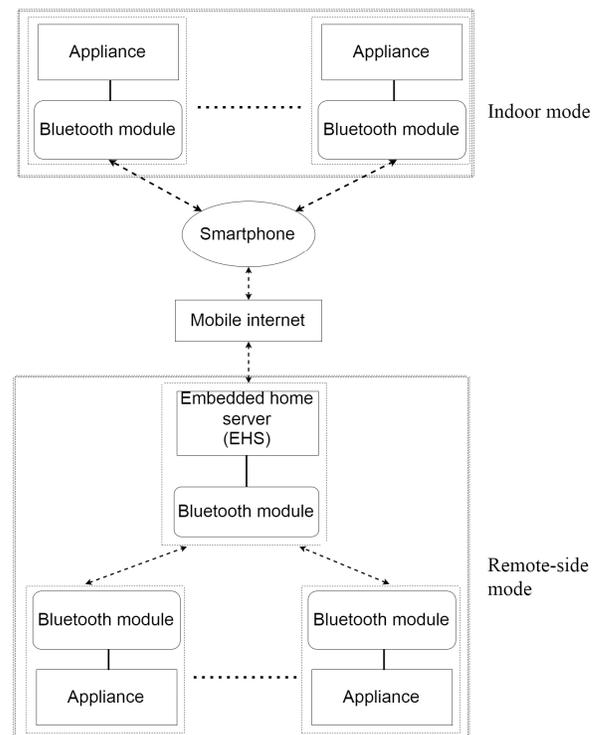


Fig. 1. System architecture.

to the embedded home server (EHS) through the mobile Internet.

For the remote-side mode management function, this design provides an abnormal status detection, by which if an order occurs and is not remotely controlled by a user, the EHS will send a notification to the user's smartphone, making it possible for a user to still monitor the operation of home

appliances even if the user is not at home. Fig. 2 shows the software flowchart.

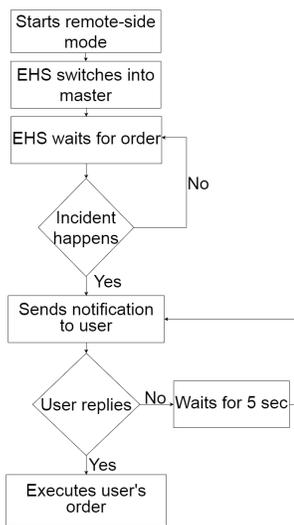


Fig. 2. Remote-side mode abnormal status notification software workflow.

III. FOUR-QUADRANT USER INTERFACE

Fig. 3 shows the user four-quadrant interface which represents the four selections of the available functions or the status for either controlling or management [3], and this floor plan is made by utilizing the Bluetooth's allocation function.

For the management of the home appliances, this design provides a user with four possible selections: Daily, Saving, Custom, and All-off. This interface also provides a user with electricity fee estimation..

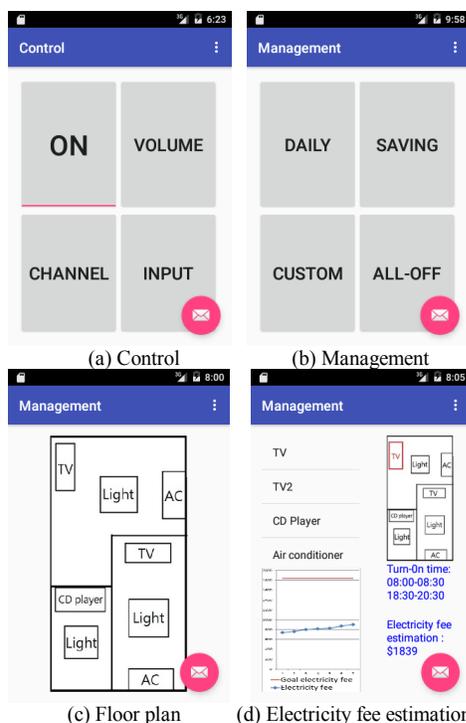


Fig. 3. Four-quadrant user interface for control and management.

IV. COMPARISON

Table I provides a comparison between our design and other designs. The comparison criteria include the connection type, whether or not there is a four-quadrant user interface or not, whether or not there is an abnormal status notification or not, and whether or not there is an indoor or remote-site mode conversion function via smartphone.

V. CONCLUSION

TABLE I
COMPARISONS OF THIS DESIGN AND OTHER DESIGNS

	Design A [1]	Design B [2]	Design C [4]	Design D [5]	Our design
Internet connection	No	Yes	Yes	Yes	Yes
Bluetooth connection	Yes	No	Yes	No	Yes
Four-quadrant User Interface	No	No	No	No	Yes
Abnormal status notification	No	No	No	No	Yes
Mode conversion via smartphone	No	No	No	No	Yes

This design uses low power Bluetooth to control and manage home appliances by utilizing a smartphone. This design also provides an automatic indoor or remote-site mode switching function which is easier for a smartphone to connect to the EHS via the mobile Internet, and then connects the smartphone to home appliances through a low power Bluetooth. In addition, this design utilizes a four-quadrant user interface, by dividing a smartphone screen into four sections which builds a simple and user-friendly interface for the user to control and manage various home appliances.

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