WiP Abstract: SHAF: Framework for Smart Home Sensing and Actuation

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I. Introduction

The Internet of things (IoT) covers various network of physical objects with actuation and sensing embedded units [1]. Under the hood, IoT uses multiple network protocols to communicate between devices. For example, different components in the physical location shares information or actuates based on received information through network communication. One of fields that takes advantage of IoT is home automation. Home automation uses different types of network protocols such as Wi-Fi, Bluetooth and ZigBee. However, existing home equipment often requires network communication enabled power plugs or devices that has a unique communication protocol specified by the company. Although these equipment have standard communication capability, each device is limited to communicate within a same network protocol enabled devices.

In order to solve this issue between various network protocols in smart homes, we present Smart Home Automation Framework (SHAF). In this paper, we present SHAF, discuss implementation details of our framework, and provide a demonstration with an example of how the overall system performs in a real-world smart home environment.

II. Implementation & Demonstration

In designing SHAF, we use Raspberry Pi with ZigBee as smart home central server and Arduino with ZigBee as sensor nodes, as shown in Figure 1. For the communication range between the central server and the sensor nodes, we assume all nodes can be reached by single hop on this implementation. However, multi-hop communication can be enabled for larger homes with additional implementation for ZigBee. In the server, Node.js implementation accepts incoming JSON query where a client can request sensor readings or operate actuation unit. Although our current client application is implemented on Android and Windows smart phone, any programming languages that can support JSON message request can communicate with the smart home central server.

Further into the details of the SHAF, it contains a database where it stores up-to-date status and history log of the smart home. For example, environmental sensing nodes such as light, temperature and humidity nodes periodically send status report messages to the server and the received information is stored in the server database. The server is implemented on Node.js and machine learning algorithm can be added. Machine learning algorithms can support automatic environment configuration based on a users preference.

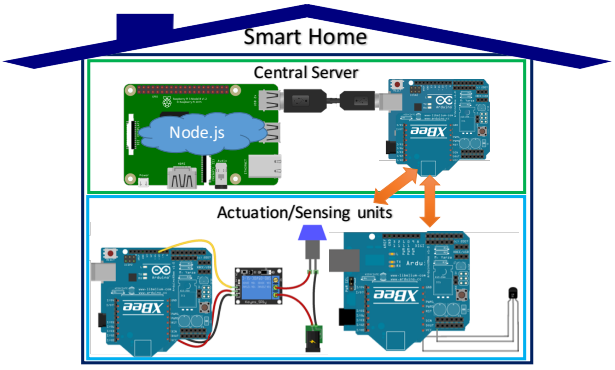

Fig. 1. Central server (ZigBee) and sensor nodes (Arduino) used for SHAF.

In our demonstration for SHAF, we show how a central server can manage multiple nodes in a smart home through ZigBee communication. Note that Ethernet and Bluetooth communication can be enabled by adding in an extra module. Our demonstration also includes user interface example cases where smart phone applications can view sensor readings and send out commands to operate actuation units.

Consider the following scenario. A user presses a button on a smartphone application to send commands and request for smart home status update. The application sends a JSON message to server and the server sends a request to the sensor nodes for the update. Depending on the number of sensor nodes in the network, the time of receiving the status update varies due to the ordering of sending the reports. The order is organized from the lowest node ID to the highest node ID. When user pushes button to operate actuation unit such as turn on light, the application sends a JSON message containing the node ID and required action information to the central server. The server receives the message and sends the message out to the sensor nodes. Every sensor node receives the request and verifies if the received message is designated for the node. If verification is correct, the node sends an actuation signal to turn on the light.

Acknowledgments

This research was supported in part by the DGIST Research and Development Program of the Ministry of Science, ICT and Future Planning of Korea (CPS Global Center), and the ICT R&D program of MSIP/IITP (14-824-09-013, Resilient Cyber-Physical Systems Research).

References

[1] D. Miorandi, S. Sicari, F. De Pellegrini, and I. Chlamtac, "Internet of things: Vision, applications and research challenges," *Ad Hoc Networks*, vol. 10, no. 7, pp. 1497–1516, 2012.