Efficient and Smarter Homes Through Presence-based Control

Kevin Estrada, Devan Hone, Afsaneh Minaie
10762956@uvu.edu, d_hone@live.com, minaieaf@uvu.edu
Computer Engineering Program
Engineering Department
Utah Valley University

Abstract

An increasing number of users are becoming more attracted to the concept of internet-of-things connected smart homes. According to Knud L. Leuth [1] in the article *State of the IoT 2018*, around 17 billion devices were connected to the internet and 7 billion were IoT devices. In a 2020 update report, Leuth [2] stated that over 21.7 billion devices were connected to the internet. Of that, 11.7 billion were IoT connections. By 2025, "it is expected that there will be more than 30 billion IoT connections, almost 4 IoT devices per person on average [2]."

Home automation systems are attractive due to their ability to easily and comfortably control and monitor a home, even from remote locations. Additionally, home automation systems can be used to minimize energy consumption. One of the largest energy consuming sectors in America are buildings (residential and industrial). They account for about 39% of total U.S [2]. energy consumption as published by the U.S. Energy Information Administration. Home automation uses technology capable of monitoring and controlling many functional parts of the house including heat and ventilating systems, lighting, irrigation, etc. And all this is done automatically saving time and resources, reducing human effort and overall making the life of people more convenient and flexible in many tangible ways.

This project aims to reduce energy consumption of home lighting while also allowing wireless and remote control of lights throughout a home. By tracking the presence of the user, the system can turn on/off lights depending on the user's travel through the home. A wireless sensor network was implemented to connect rooms of a home. Each room node replaced the existing switch and was used to detect motion inside the room. Each node reported such presence to a central node. The central node determined what lights in the house should be turned on or off based on movement to and from each room node using an adjacency matrix specified by the user. A relay was connected to each room node which allowed for control

through the central node's adjacency algorithm or through an Android mobile application. A mechanical push button was utilized as a manual override to the smart light system. Additionally, through the Android app, customization of "active" and "sleep" times was implemented. While the system was in "sleep", only the app and manual control would turn on lights. During "active", the adjacency algorithm would control the lights, allowing only one light on at a time and followed the user throughout the home.

This project focuses on the potential of providing great flexibility to homeowners with the advantage of allowing them the operation of the system remotely. Localizing the control board on a single device promotes convenience and practicality —a massive improvement for technology and home management. A substantial aspect behind the design of this project is the better usage of energy. An average household dedicates 11% of its energy budget to lighting [3] and implementing a smart light control system such as the system that was designed in this project reduces the cost of energy consumption while simultaneously providing ease of use and flexibility.

References

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