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Department of Computer Science

COS 730 Assignment 1

X10 Home Automation

1. Research X10 home automation

X10 is a communication protocol primarily used for home automation. Developed in 1974 by Pico Electronics [2], X10 was the first step to a practical illustration of home automation. It pioneered the field of home automation soon after its release. It basically enables electronic devices within a home to communicate with each other and the controllers through existing electrical wiring [1].

Communication Protocol: X10 operates on a simple and robust communication protocol. Commands are transmitted over the existing electrical wiring during zero crossings. When a command is sent, it is modulated onto the electrical power line at a 50/60 frequency and received by the intended X10-compatible device[3].

Devices: X10-compatible devices are installed in homes. These devices include light switches, lamp modules, appliance modules, motion sensors, security cameras, thermostats, etc[4]. Each X10 device has a unique address code that allows it to be identified and controlled individually or as part of a group[5].

Control Interfaces: Users can control X10 devices using various control interfaces, including [6]:

Remote Controls: allow users to send commands to X10 devices from anywhere within the home. Smartphones and Tablets: users can control X10 devices remotely over Wi-Fi or cellular networks that have a collaboration with the latest communication protocols. Computers: X10 software

applications running on computers provide advanced control and automation capabilities, allowing users to create schedules, macros, and customised automation routines.

Commands: X10 supports a variety of commands for controlling devices, including:

On/Off: Turn devices on or off remotely. **Dim/Brighten:** Adjust the brightness level of compatible lighting devices. **All Lights On/Off:** Simultaneously control all lights or devices in a specific group.

Timers: Schedule devices to turn on or off at specific times [6].

Macros: Create sequences of commands to automate complex tasks or scenarios[6].

Weaknesses contributed to x10 losing favour:

Interference: X10 communication can be susceptible to interference from other electrical devices and noise on the powerline, leading to reliability issues [7].

Range: X10's range may be limited by the quality of the electrical wiring in a home, and signal degradation over long distances can affect reliability [8].

Limited Bandwidth: X10's bandwidth is limited, which can restrict the number of devices that can be controlled simultaneously and the speed of communication [8].

Compatibility: Compatibility between different X10 devices and manufacturers may vary, leading to interoperability issues [8].

Lack of security: The doesn't have any encryption [8].

Low Performance: Due to range, bandwidth and interference [8].

2. Software requirements specification

Introduction

X10 home automation was introduced by pico electronics with the vision of enhancing functionality and convenience of home automations. The trivial tasks and control of home appliance, lighting ,home security systems ,etc could easily be automated and controlled by one device. X10 scope encompassed a fully autotimed home systems that rely on Electrical wiring to ensure well-being and comfort. This scope includes software,hardware needed to completely automate homes [9]. The long term goals for x10 home automation was for a robust,affordable, user-friendly, reliable and convenient for home owners. The X10 home automation serves as a time saving and convenient system to home

owners. Home owners have are freed from trivial tasks and scheduled events, x10 relieves owners by automating the scheduled events through triggers that complete the tasks for owners based on personalised configuration. The x10 is a robust protocol that helps communicate messages between controllers and modules but it has a couple of limitation, extension of cloud solution to remove x10 limitations will be the area of focus.

User Characteristics

- Homeowner status: Users should be responsible of property and have permission to install permanent setups and renters could have less permanent solutions.
- Interested in home automation: users are likely to be interested in smart homes and its potential benefit. Creates an expectation.
- Technically inclined to a certain level: users should be able to understand usage terms , maintainance manual and customisation manual.
- Physical attributes: Users should be able to operate the remote/device used to communicate with coontroller of the home system.
- Read : users should be able to read in order to be able to operate the home automation system efficiently.
- budget and affordability: users can be able to purchase upgrades for home systems to have new improvements and be compatible to other systems incase of any need of integration

User Story

Functional Requirements

1. Components :

Hardware Component (Assumption : Not to be too emphasised)

- Transmitter
- Reciever
- powerline communication modules
- wireless modules
- sensors

Software Components

- Notification Managements
- Device Management
- Data management
- Cloud Service (additional component)

- Logging and Reporting (additional Component)
- Schedule Management
- Access Control System
- Controller interface

1. Functions of each component :
2. Use case diagram :
3. Traceability Matrix :

Class/Component Domain model diagram

High level non-functional requirements

Bibliography

[1] T Perry, "The Definitive History Of Smart Home Devices", Smart home point, November 14 2019, Available:
<https://www.smarthomepoint.com/history/#1965-to-1991-the-necessary-tech-is-invented>

[3] X10 WWW pages, How x10 works [online], Available :
<https://web.archive.org/web/20190402195647/https://www.smarthomeusa.com/how-x10-works/>

[4] x10, X10's ActiveHome™ Kit - Welcome to the 21st Century [online], Available: <https://www.ipcf.org/article/1113/x10s-activehome-trade-kit-welcome-to-the-21st-century.html>

[5] J Burroughs (Microchip technology Inc), (2010, May 1), X-10® Home Automation Using the PIC16F877A [Online], Available:
<https://ww1.microchip.com/downloads/en/AppNotes/00236B.pdf>

[6] X10, What is x10 Home Automation [online], Available:
<https://www.x10.com/pages/allaboutx10>

[7] "X10 devices and standards" [online], Available: <http://www.x10.com>.

[8] C. Withanage, R. Ashok, C. Yuen, K.N. Otto, "A Comparison of the Popular Home Automation Technologies", 2014 IEEE Innovative Smart Grid Technologies - Asia (ISGT ASIA), Future Living Lab Engineering Product Development Pillar Singapore University of Technology and Design Singapore, 2014, pp 3-4

[9] "My life at x10" [Online], Available: <https://web.archive.org/web/20161015080410/http://www.hometoys.com>