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ADVANCING THE STATE OF THE ART
An “operating system” for connected devices in the home

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Connected devices for the home

Inexpensive

Need “no new wires”
  • Use regular voltage or batteries
  • Wireless communication

Use maturing, reliable standards
  • Z-Wave, ZigBee, Powerline
Why smarthomes?

Convenience

“It allows me to be lazy”

Peace of mind

“I can track things when I’m not there and know that...it’s...secure”

Control

“I like just being in control”

[Home automation in the wild: Challenges and opportunities, CHI 2011]
Why not smart homes?

Manageability

Extensibility
Existing abstractions for home tech

Network of devices

Management is still hard
• Users must manage each device/task
• Developers must deal directly w/ h/w

Appliance
• Monolithic systems

Extensibility is still hard
• Closed set of tasks
• Closed set of devices
Our abstraction

Organize the home as a PC

- Networked devices =~ peripherals
- Tasks over these devices =~ apps in high-level APIs
- Adding devices =~ adding a peripheral and driver
- Adding tasks =~ installing an application
- Managing networked devices =~ managing files

[The home needs an operating system (and an app store), HotNets 2010]
HomeHub centralizes all devices for users and apps

HomeStore helps find compatible devices and apps

HomeCloud enables remote access and control
Device discovery, pairing, and comm. for multiple protocols (e.g., DLNA, Z-Wave)

Device capabilities are exported as services
- Decouples apps and device protocols
- Allows for differentiation by vendors

Apps use high-level abstractions
- Simplifies app development
- Manifests enable compatibility checks

Primitives are specialized to home setting
- Simplifies management

Device functionality

Mgmt. and access control

Application

Device connectivity
Prototype

Software module based on .NET and C#
  • 20K lines of code (~3K kernel)
  • 18 diverse apps (~300 lines per app)

Support for several protocols and devices
  • Z-Wave, UPnP, DLNA, custom (HTTP)
  • Dimmers, light switches, cameras, motion sensors, d/w sensors, ....

In-lab and field evaluation
  • Deployed in 12 homes
  • 50 students across 12 institutions have developed apps and drivers
Sample 3\textsuperscript{rd} party applications

For more, see http://research.microsoft.com/homeos/
Ongoing and future work

Predictable control

Sensor data privacy

HomeLab: Shared research testbed

[HomeLab: Shared infrastructure for home technology field studies, HomeSys 2012]
Offers a PC-like abstraction for devices in the home

- Simplifies management for users
- Simplifies extension by users and developers

http://research.microsoft.com/homeos/