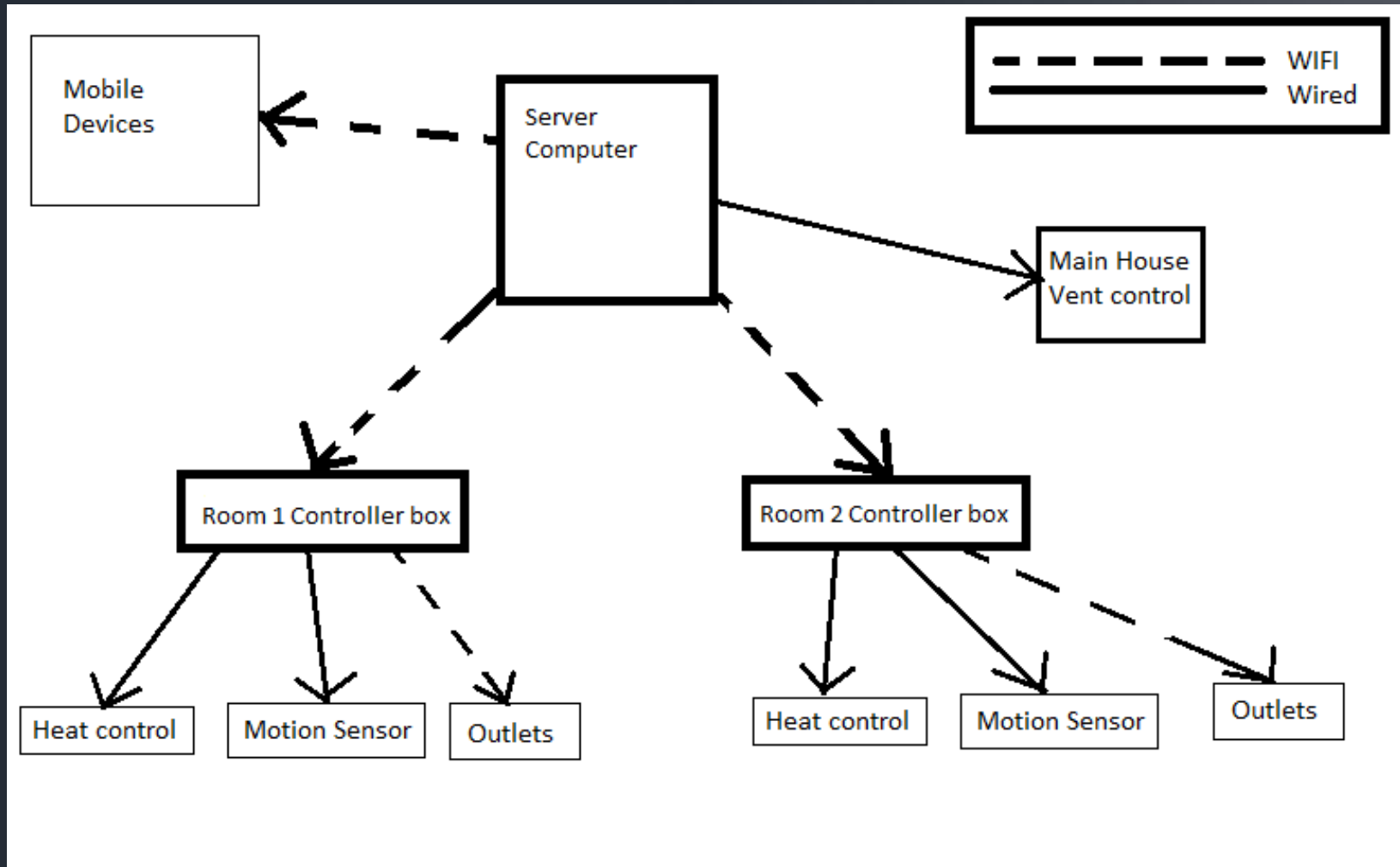# Smart Home

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Overview

- thermal control
- outlet control
- occupancy detection
- Wi-Fi and networking
- Purchased vs Designed

Thermal Control

1. Temperature controller that takes advantage of outside weather using the following
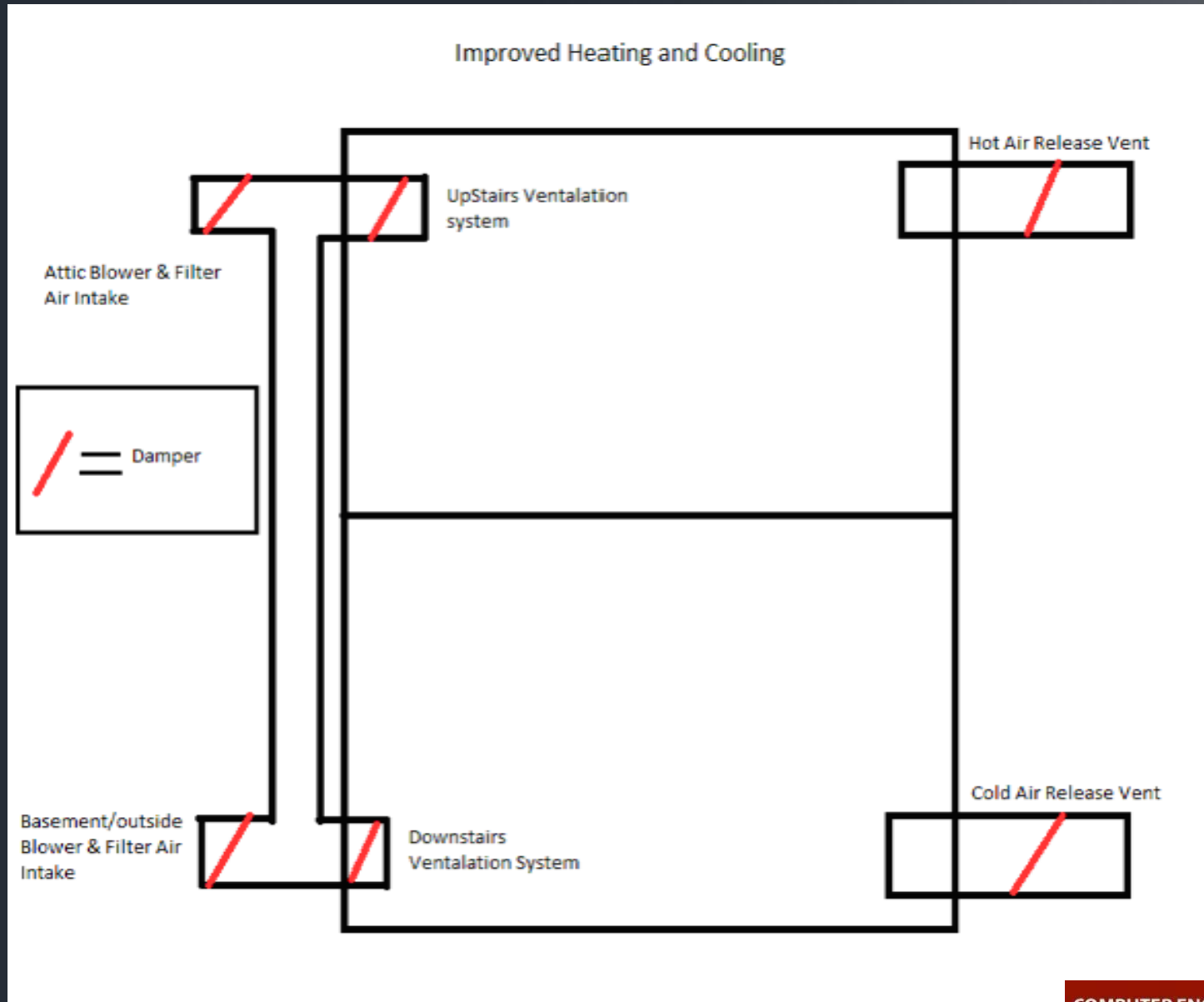   - dampers to control air source
     - stepper motors
   - blowers to control air flow
   - LM 335 AZ temperature sensors to the know best source and distribution
   - 12V power supply

Thermal Control

Improved Heating and Cooling

Hot Air Release Vent

UpStairs Ventalation system

Attic Blower & Filter Air Intake

/ ▬ Damper

Basement/outside Blower & Filter Air Intake

Downstairs Ventalation System

Cold Air Release Vent

Thermal Control

1.Software
  – Dampers need a motor controller and software to interface with them.
  – Temperature sensors need an analog input.
  – Blowers need a PWM signal to control the speed.
  –If using a furnace blower, a digital I/O line will be needed to control the relay.
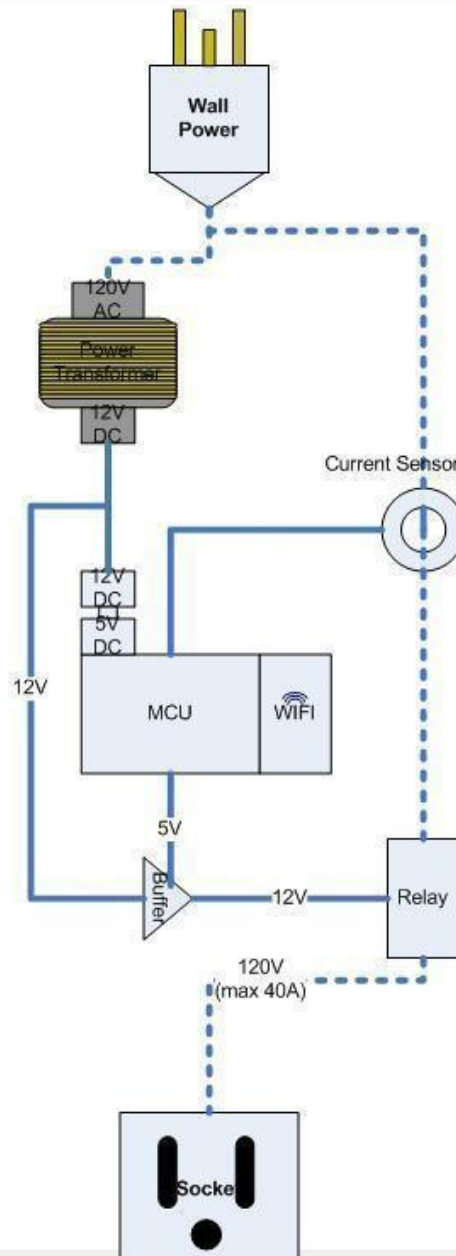
Outlet Control

1.Powerstrip design
  –Switch power on/off via commands from onboard MCU.
  –communication via Wi-Fi
  –power statistics/monitoring
  –surge protector (maybe)

Outlet Control

1. Problems
   - monitoring large range of power with one sensor
   - high amperage relay with low voltage coil
   - onboard power transformer to run MCU/Wi-Fi.
   - How do we address multiple Powerstrips?

Why is room-based occupancy detection so important?

1.Convenience
   – Lights and appliances can be turned on and off automatically without needing to always be flipping a switch
●Efficiency
   – Forgetting to turn off lights and appliances wastes energy and can run up the electric bill
   –Heat and air conditioning can heat or cool unoccupied rooms or areas less to conserve energy
●Security

How has room-based occupancy detection been performed?

Usually just with PIR (passive infrared) motion sensors and timers.

Motion sensor activity makes the room assumed to be occupied for a set time period after which, with no further motion, the room is deemed unoccupied.

Problems with PIR-only occupancy detection

●Periodic motion is required to main the occupied status of room.

●This Leads to two problems:
  –Short timer durations makes it necessary for occupants to be periodically waving at the motion sensor as it repeatedly mis-concludes that the room is empty.
  –Long timer durations mean that the room is not judged to be unoccupied until long after it has been vacated.

What are light beam interruption detectors?

1.Light beam interruption detectors (LBIDs) have a transmitter which shoots a beam of light, often an invisible one, across a distance to a receiver, which outputs one signal when the beam is received and a different signal when the beam is not received because of an obstruction between the transmitter and the receiver.

How can LBIDs improve occupancy detection?

●Whether a room is occupied or vacant, its status cannot change without someone walking through a doorway (ruling out windows).

●If a light beam interruption detector is placed across each doorway to a room, people will not pass through such a doorway without producing a change in the output of the detector.

How can LBIDs improve occupancy detection? (continued)

1. When combining a PIR motion detector with LBIDs at all entrances and exits to a room, the occupied or vacant status of a room need only be determined ONCE after the LBID signal changes and the status of the room will remain the same so long as the LBID signal remains constant.

How does a system with both PIR motion sensors and LBIDs work?

When an LBID bordering two rooms is tripped, both rooms begin counting down from 5 to 10 second toward zero. Which ever rooms are occupied sense motion and sets their state accordingly. Otherwise after a room counts to zero, its state is set to vacant. If motion is detected in a room after its state is presumed vacant, it is changed to occupied.

Using occupancy detection with lighting

With lighting, usually the lights are turned on in both rooms adjoining an LBID, before it is ascertained which room(s) is occupied. Other than this, the lights turn on when the room is deemed occupied and go out when the room is deemed vacant.

WIFI

● Arduino MCU will send data from sensors over the WIFI interface

●TCP/IP protocol communication to Server.

●Unsecured, WEP, and WPA

Purchased VS Designed

1.Purchase
   – Blowers, Sensors, Computer (server), Motors, Router, Apache software, Chips, blank PCB, and passive components.

● Design
   – Controller box, Dampers, Power strip, Wifi, and Room Occupancy