THAT Home Automation Topology (THAT)

Digital Thermostat Module
Electronic Access Module

Functional Requirements List and Performance Specifications
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Project By:
Nick Viera
Chris Miller

Advised By:
Dr. James Irwin
Dr. Aleksander Malinowski

Summary

THAT System:

The terms “home automation” and “building automation” are often used to describe a wide array of products and systems. These products aim to provide the user(s) with better, more-intelligent control over their environment as it relates to a home, building, or other indoor space. Unfortunately, most “automation” products are either inexpensive, simplistic, and severely limited in functionality, or they are very expensive, complex, and functionally chaotic.

THAT Home Automation Topology, also known as THAT System, describes a new, comprehensive, IP/Ethernet-based home automation system. THAT System is designed to be as modular and economically feasible as possible, while retaining a rich, usable feature set.

Digital Thermostat Module:

The Digital Thermostat Module (version 1.0), code-named COPTA, is an advanced control module for use with THAT System. As such, the COPTA design shares the basic goals and requirements defined for THAT System. This module will be developed by Nick Viera in collaboration with Chris Miller.

COPTA is an advanced, digital thermostat with an advanced feature set and programmable control. It is designed for use with most standardized residential and light-commercial, single or split-unit HVAC systems. COPTA can perform most basic functions as a stand-alone device or it can be integrated into a larger THAT System to provide maximum flexibility and functionality.

Electronic Entry Module:

The Electronic Access Module (EAM) shall be a flexible entry and security system, equipped with programmable control, that shares the basic goals and requirements defined for THAT System. It will be designed for residential and light-commercial buildings. The EAM will be able to function as a stand-alone device or in a larger THAT System to provide maximum flexibility and functionality. This module will be developed by Chris Miller in collaboration with Nick Viera.

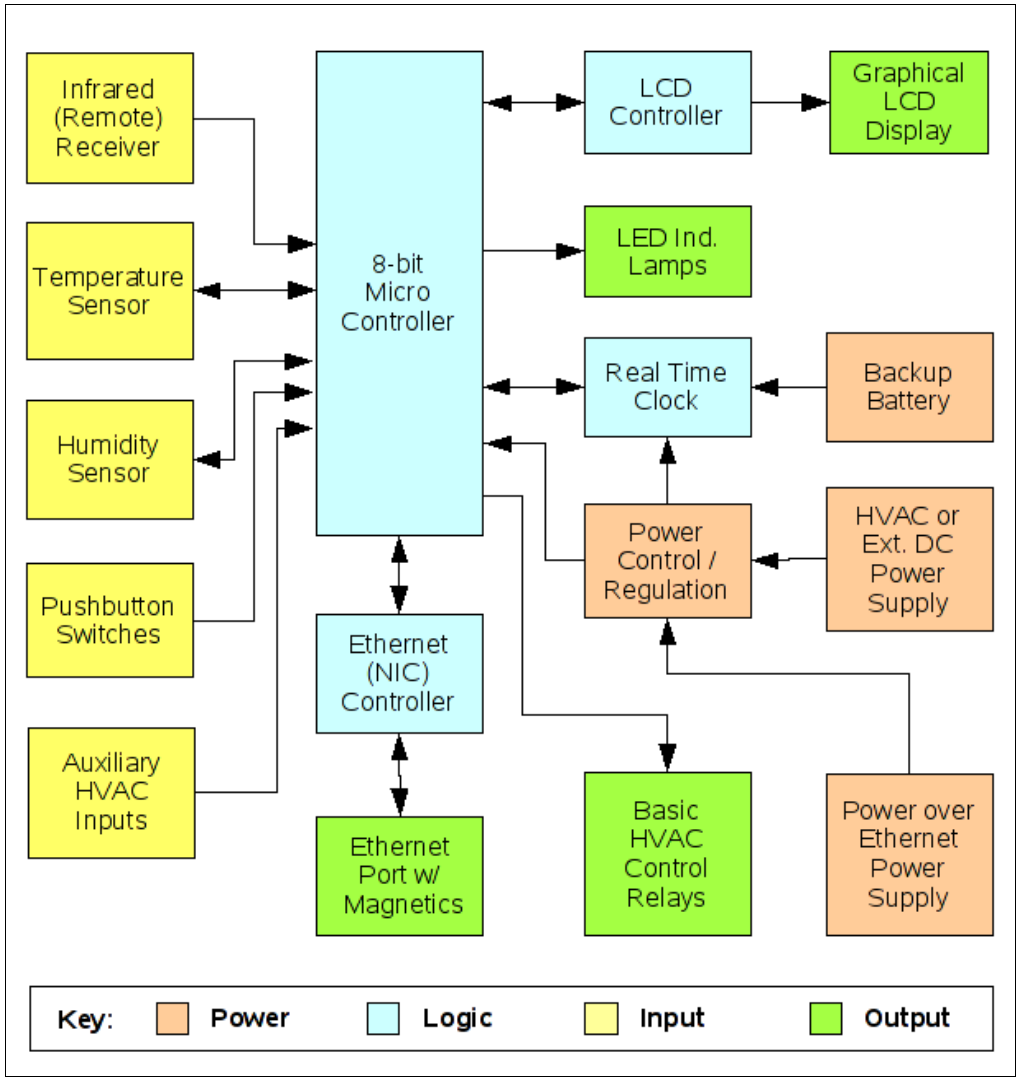

Figure 2-1: COPTA Hardware Block Diagram

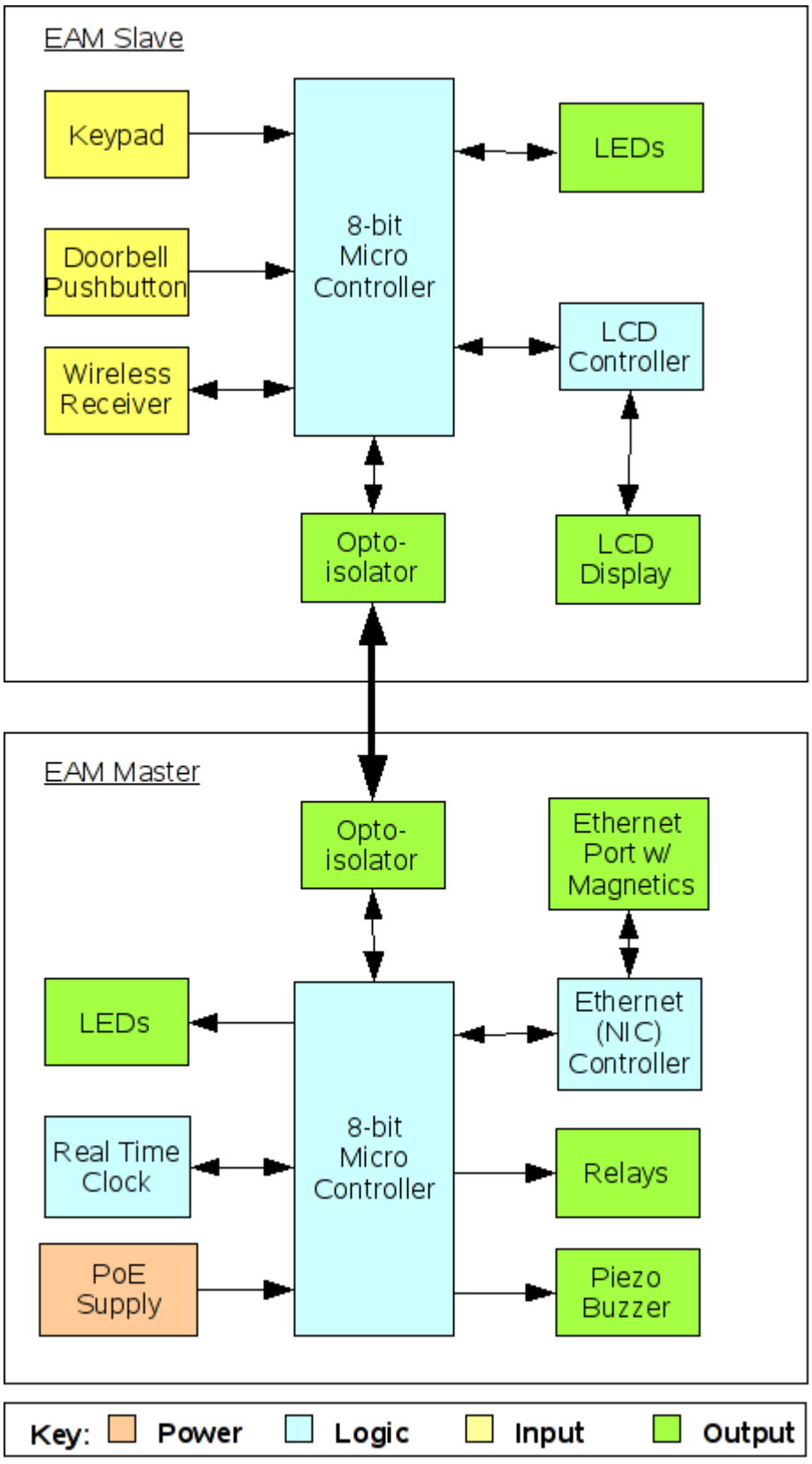

Figure 3-1: EAM Hardware Block Diagram

Functional Requirements

Common Requirements (THAT Topology):

- Hardware
  - Link protocol: 10BASE-T, 100BASE-TX Ethernet
  - Data port(s): 8P8C Modular jack
  - External power port: 2.1mm barrel jack
  - Primary power supply: IEEE 802.3 Power over Ethernet (PoE)
  - Secondary power supply: 12-48 VDC or 9-30 VAC [1]
- Software
  - Data transport protocol: TCP
  - Internet protocol: IP [2]
  - Data port: 8428
  - Host type: Server [3]
  - Provisions for master-control of a THAT system using a software client. [4]

[1] The presence of the secondary AC/DC power supply, such as that from a “wall-wart” or other point-of-use power supply, shall take precedence over (and disable) the sourcing of any power from the PoE supply.

[2] Initial THAT modules shall support IP, version 4. While modules can support IP, version 6, this support is not required for THAT conformance.

[3] All modules shall default to being servers on the network, listening on port 8428. Modules are allowed to optionally be set to communicate as clients and/or using other TCP ports. However, such behavior shall never be the default mode of operation.

[4] A “master” control software suite is planned for THAT system. The software shall be written using the Python programming language and should act as a client on the network to send and receive data with as many modules as necessary. Additionally, the software will provide more robust control of THAT system through its position as a “master” data controller.

Digital Thermostat Module:

- Hardware (See the block diagram, Figure 2-1.)
  - Platform: 8-bit Atmel AVR microcontroller (most likely Atmega328)
  - Ethernet: Hardware ethernet interface controller such as Microchip's enc28j60 IC
  - Graphic, back-lit, monochromatic LCD display.
  - Integral temperature and humidity sensors.
  - Integral outputs for simple 24VAC HVAC system control (Heat, A/C, Fan). [1]
  - Support for advanced 24VAC HVAC system control (w/ separate relay module). [2]
  - Integrated relays capable of switching at least 1A at 24VAC. [1]
  - Five (5) LED indicator lamps for quick system status notification.
  - Real time clock with calendar.
  - Non-volatile memory for storing "permanent" system settings.
  - Battery-backup for temporary settings and RTC.
  - Infrared Receiver
- Software
  - C and AVR assembly languages as needed.
  - Configurable support for single and multi-stage A/C and heat-pump systems. [2]
  - Configurable support for reading external temperature/humidity sensors. [3]
  - “Learning” of codes from standard Infrared remote controls.
- Packaging
  - Form Factor: Wall mount, round.
  - Physical size: Approx. 4.5” diameter, < 2” depth. [4]
  - Main user interface: 6-button direct input, LCD/LED output.

[1] The thermostat shall contain three (3) on-board relays for direct control of the three basic HVAC functions: Fan, Heat, and Air Conditioning.

[2] The addition of separate relay module(s) to a THAT system will allow for control of more advanced HVAC units such as those with dual-stage cooling and heat pumps. The thermostat shall be capable of interfacing to an external relay module (by acting as a TCP client) in order to directly trigger the additional relays.

[3] The thermostat shall have provisions to directly interface to an external temperature and humidity sensor in hardware (i.e. non-ethernet sensors). However it shall also be able to receive readings from other temperature/humidity sensors on the network, through the help of additional THAT software.

[4] The thermostat shall be physically no larger than standard wall-mount thermostats. It is important that the thermostat be able to replace existing thermostats without significant physical modifications.

Electronic Access Module (EAM)

- Hardware (See block diagram, Figure 3-1.)
  - Platform: 8-bit Atmel AVR microcontroller (most likely Atmega328)
  - Ethernet: Hardware ethernet interface controller such as Microchip's enc28j60 IC
  - Monochromatic VFD or backlit LCD display
  - Passcode keypad
  - Doorbell button
  - Wireless receiver for basic lock/unlock remote control
  - Wireless key-chain dongle support (AES encrypted)
  - LED indicators for quick system status notification.
  - Real time clock with calendar.
  - Non-volatile memory for storing "permanent" system settings.
  - Battery-backup for temporary settings and RTC.
- Software
  - C and AVR assembly languages as needed.
  - Configurable support for access input modules. [1]
  - Configurable support for access output modules. [2]
  - Configurable support for security input modules. [3]
  - Configurable support for security output modules. [4]
- Packaging
  - Form Factor: Wall mount, rectangular.
  - Main user interface: 6-button direct input, LCD/LED output.

[1] The EAM master module will support all access input THAT modules such as keypads, wireless dongle receivers, RFID / magnetic card readers, etc. The EAM slave will be created as a convenient, single module for home use (includes a passcode keypad, LCD, doorbell button, and wireless dongle receiver).

[2] The EAM will support all access output THAT relay modules for controlling electronic door strikes, keyless deadbolts, magnetic door closers, etc. Additionally, the master module will contain three built-in relays for controlling access hardware without the need for additional THAT relay modules.

[3] The EAM will support all THAT security input modules such as proximity (door and window), smoke and carbon monoxide, motion, water, etc.

[4] The EAM will support all THAT security output modules such as sirens / annunciators, phone / SMS / email notifiers, X10 / Insteon (lighting), etc. Additionally, the master module will have a built-in piezo buzzer which can be used in place of (or along with) other security output modules.