# Wireless Home Control System

*Reimagine your home* ™


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## 2.1 Motivation

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## 2.3 Objectives

In order to enable homeowners to have the best experience with their new WHCS, we will explain our core project objectives. These describe what the end-users are be able to do with the system at a high level.

3 pages

### 2.3.1 Voice Control

Voice control from a supported, BlueTooth enabled, Android device will allow the user to remotely activate any part of the home that is integrated with WHCS. This would include activating lights, unlocking doors, turning off and on appliances (by controlling their respective outlets), querying sensors, and any other home specific applications.[1] All of these *actions* and *targets* will be able to be used just from the user's voice. Voice actions will be specific to each target, but they will consist of verbs such as **turn**, **query**, **check**, **open**, **close**, and so on. The list of targets will directly correspond to the number of control modules listed in the home and their type. This will be explained in more detail in Section 4.

### 2.3.2 Light Activation

Through activating lights and querying their status remotely, a homeowner will no longer have to be present in the same room as the switch. By connecting lights to WHCS, they will become integrated in to the home network and not be isolated in each room of the home. With just a spoken command or a tap on their smartphone, lights will be controlled. By automating the process of toggling light switches, WHCS will have the ability to be smart about when they are ON or OFF, freeing the user from having to think about their state at all. In addition, lights, just like all of the other connected control modules in the home, will be able to be actuated on a specific schedule. This schedule can be designed by the homeowner to meet their daily lives or in a special circumstance, such as travel.

make a section for scheduling or remove

### 2.3.3 Outlet Activation

Lights aren't the only actionable thing in the home. There are a multitude of applicances throughout the home which could benefit from remote control. Some of these include

[1] WHCS is an extensible system. Control modules are built with a plugin-like interface, allowing for intrepid home owners to have a fully custom home. This combined with the control module's free breadboard area, new applications may be created.

coffee makers, toasters, or computers. If integrated with WHCS through outlet control, these appliances would be able to be apart of the home network. Imagine being able to start the morning coffee from the comfort of the bedroom. This would be possible with an appropriate coffee maker and WHCS outlet control. An added benefit from having outlets being automated is that there would be less draw from power leeching devices' power subsystems, which may be always-on.

find some better examples

cite article hyping up how much power you lose to leeches

### 2.3.4 Door Access

In addition to controlling home lights and various appliances, giving users remote control of their doors is a goal of WHCS. Through the use of an *electronic door strike*, we would provide specific control module the capability of locking and unlocking a door. This functionality would be demonstrated in Demo 10.5. WHCS sees door access as important for a home automation system to support because remote access, like a garage door, is simple and easy. We want to make opening *any* door simple and easy.

Unlike controlling appliances and reading sensors, correctly managing the operation of a safety-critical door must be handled with great care. Any flaw in the implementation of the WHCS network would leave a user's home vulnerable to outside attack. This is why any control module whose purpose is to control doors will support additional security features. These additional features will include mechanisms to prevent replay attacks (which garage doors are vulnerable to) and also prevent outside attackers from engaging the door opening mechanism just by sniffing traffic. For additional details on the security considerations of WHCS, please refer to Section 3.3.

### 2.3.5 Data Collection

In order to give users a broad overview of their home's state, WHCS supports the collection of data from *arbitrary* sensors. Data collected can include temperature, humidity, light level, sound levels, and so on. Each home may have sensors throughout collecting various data that the homeowner deems useful. The sensor integration with WHCS would be transparent to the user. All they would see would be the list of sensors and the corresponding values. WHCS's pluggable control module's would be tailored to each sensor or set of sensors, which would relay their data back to the base station. This is illustrated in Figure 1. The base station would support queries from the LCD interface and simultaneously from a connected phone.

Beyond home sensors, all of the the other controllable objects in the WHCS would have metadata being collected about them at all times. This extra metadata would include **connection status** and **power status**. See Section 5.1.4 for a more detailed description of the supported network packets and the type of fields they support.

All of this raw data being collected could be displayed to the user in the form of graphs and tables. It would also serve as the basis for a set of descriptive statistics for display to the user.

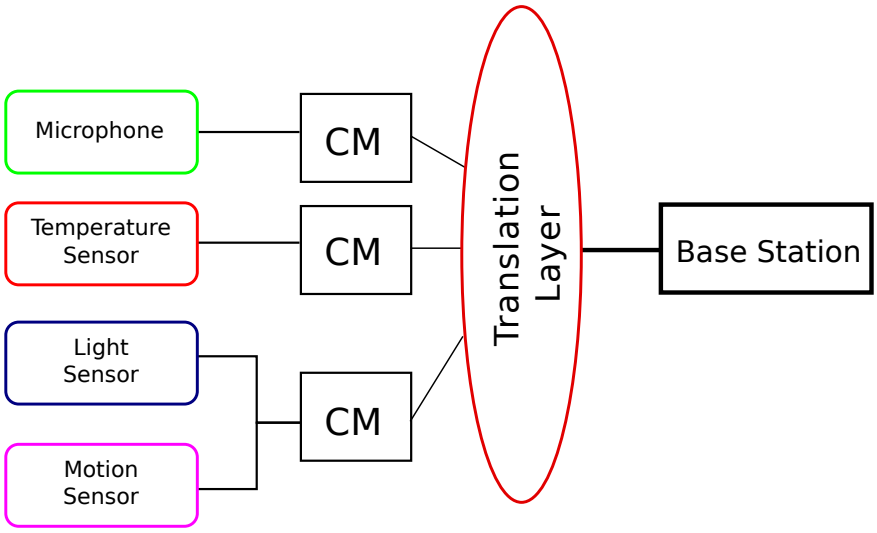


Figure 1: A illustration showing the translation of many different sensor nodes to WHCS' protocol

## 2.4 Requirements and Specifications

## 2.5 Research of Related Products

### 2.5.1 Z-Wave

### 2.5.2 Belkin

### 2.5.3 Apple HomeKit

### 2.5.4 Nest Labs

Unlike the previous companies, Nest Labs is quite new, but has certainly claimed its space in the smart home market with its smart Nest Thermostat. Their other product, the Nest Protect, a smart smoke and $CO_2$ detector, integrates smoothly with the thermostat allowing for remote monitoring and control of the home. 0.5 pages

Nest Labs was recently purchased by Google for $3.2 billion dollars, which certainly gives the company a powerful position in the market. One of Nest's goals is to have a *platform* for other companies and developers to create new products that *Work with Nest* $^{TM}$. This strategy is clever as now the success of the company will grow with every new device and developer who chooses to integrate their products with the Nest suite.

In terms of functionality, Nest has a online web interface and a mobile app that will display all of the networked devices, allowing for a highly connected experience.

#### 2.5.5 X10

0.5 pages

# 3 Realistic Design Constraints

EXPAND: as per Richie's advice to use the PPT for section

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0.5 pages

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Talk about pin count and having to disable the JTAG fuses to get access to those pins

Talk about the speed grade for the CPU and why a higher grade would be faster

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whole section

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1 page

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2 page

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1 page

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2 page

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### 5.8.5 Sensor Collection

### 5.8.6 Light Control

SECTION: add "Summary of Related Standards" and merely reference them

# 6 Printed Circuit Board

## 6.1 Software Considerations

Before designing any of our Printed Circuit Boards, we decided to analyze which software would allow us to do the job the quickest and easiest. Nearly all of the team was familiar with EAGLE as it's one of the most talked about board design software due to its EAGLE Lite version. Instead of going with the most common solution, we decided to compare EAGLE CAD to another open source solution: KiCad.

1 more page if possible

### 6.1.1 EAGLE

EAGLE PCB is commercial software for schematic capture and board layout. It supports a wide variety of features that would help us make our board. The only issue is that the normal software costs money. Luckily they offer a free evaluation version that can only be used for non-commercial purposes.

This freeware version of EAGLE has strict limitations in the size of the board that can be designed and how many signal layers there may be. The size of any board is limited to 4 x 3.2 inches[2] and there may only be a top and bottom copper layer. These limitations would be a show stopper for a moderately complex board, but considering our project requirements, it would be suitable. If we are to consider future board designs for WHCS, we may want a more flexible solution.

### 6.1.2 KiCad

As an alternative to EAGLE PCB, KiCad performs admirably well. It has all of the primary features of EAGLE and yet, is completely free and open source. The benefit of this is that the whole suite of tools is cross platform, allowing group members to easily work together despite different operating systems.

One issue with KiCad is the lack of a built in Autorouter. KiCad provides an external router, FreeRouting[3], but it has experienced recent legal trouble due to one of the developers previous employers.

[2] http://www.cadsoftusa.com/download-eagle/freeware/
[3] http://www.freerouting.net/

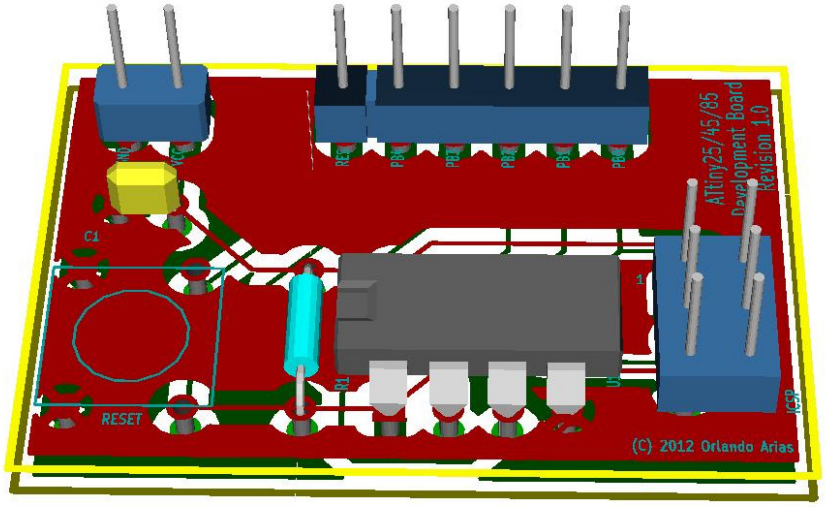


Figure 2: an ATtiny development board displayed in KiCad's 3D board view

Another nifty feature that KiCad has is its 3D board view. Figure 2 shows the 3D view of an example board by Orlando Arias[4]. This feature is great for getting a sense of your board layout in relation to the selected footprints.

[4] A $3^{rd}$ year Computer Engineering student at UCF

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### 10.5 Remote Door Access

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## 11 Project Management

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### 12.2 Appendix B - Tables

### 12.3 Appendix C - Complete Schematics

### 12.4 Appendix D - Copyright Notices