

Engineering Requirements Document (ERD)
Smart Home Appliance Control System (SHACS)

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1. Introduction

1.1 Scope

The Smart Home Appliance Control System, also known as SHACS, will allow a user the ability to control several common household items: household fan(optional), light bulb, thermostat, and controlling the blinds. The user will be able to wirelessly control these items from anywhere in their home.

1.2 Identification

The product will be identified as the Smart Home Appliance Control System, also known as SHACS.

1.3 Project Overview

The SHACS will have one main module and four other modules that will be connected to it via wireless communication. The other modules will include: Light Control Module, Fan Control Module(optional), Window Blinds Control Module, and a Thermostat Control Module. These modules will be controlled by the user through the main control module (Light and window blind modules can be autonomous, if desired.)

1.4 Limitations

The following are NOT features of this project:

- ³⁵₁₇ Cannot use outside of home
- ³⁵₁₇ Does not have connectivity to smart phone
- ³⁵₁₇ Personalized/customizable user profiles

1.5 User Characteristics

A user can range anywhere from 8 – infinity years old, but here is a list of some target characteristics of users.

Primary:

- Elderly People
- People with permanent disabilities (primarily those with walking problems)

Secondary:

- Anybody who wants control over their home appliances

1.6 General Constraints

- ³⁵₁₇ Designed with a small budget
- ³⁵₁₇ Due to the star network topography, the modules will only be able to talk to the main control module and not any neighboring modules.
- ³⁵₁₇ Xbee series 1 wireless communication has a range of only 100m (300ft)
- ³⁵₁₇ The module has to become part of the appliance, so it is not adaptable to other appliances, besides the one it was made with.
- ³⁵₁₇ Limited to battery life of 3 x AAA batteries

1.7 Assumptions and Dependencies

- ³⁵₁₇ Person using system is within the required range of the xbee networking capabilities.
- ³⁵₁₇ System modules will be powered by 3 x AAA batteries, so the system is dependent on a power source that will eventually run out having the user to replace the batteries every so often.
- ³⁵₁₇ The SHACS will only be able to support these said modules in the provided documents.
- ³⁵₁₇ Fan and Light modules rely on main voltage to turn appliance on. User must have access to wall outlet or 60 Hz 120Vac.

2. Product Requirements

2.1 Features and Functions

Touch Screen on Main module – User will be able to interact with the TFT LCD to tell the system what to do along with requesting data from the other modules. The main module will include a interactive easy-to-use display menu for the user. The user will be able to select from the different modules inside the menu.

Light Control – User will be able to turn on and off a light bulb. The user will be able to dim the light to a specified brightness. The module will also have an autonomous mode that will turn on the light according to a trigger from a PIR sensor. Additionally, the user will be able to request voltage and current statistics from appliance.

Fan Control(Optional) – User will be able to turn on and off a household fan. The user will be able to vary the fan to a specified speed. Additionally, the user will be able to request voltage and current statistics from appliance.

Thermostat Control – User will be able to see the thermostats status and temperature/humidity. The user will also be able to set the thermostat to a specific set point that will control the switches to the AC/HEAT/Fan units. The thermostat module will also be programmed to inform the user that they are/aren't using energy saving techniques during the summer and winter months. The user will be able to request temp/humidity readings from modules.

Blind Control – User will be able to control the blinds to open or to shut them. The module will also be able to run autonomously with the input coming from the lux sensor and the module determining whether or not to shut or open the blinds. Along with being able to do that, the user may request a log of the suns intensity throughout the day.

2.2 User Interface

The user interface will be on the main control module. On this module is a TFT LCD screen that the user will use to interact with the entire system. The user will be able to touch icons on the screen to tell the control system which appliance to control or even request certain data

from said device.

2.3 **External Interface Requirements**

The Xbee series 1 will have to be externally interfaced with the STM32 boards.

2.4 **Installation Requirements**

All the user will have to do to install the system is to add batteries and supply main voltage for the fan and light control modules. Some set up might be required for window blind module such as fitting blinds rod with servo motor. Everything else included.

2.5 **Design Constraints**

³⁵₁₇ System is at the mercy of the network range capabilities. It was a design/budget choice to go with the cheapest xbee therefore limiting the design.

³⁵₁₇ Thermostat module will not actually have switches for A/C unit or Heater unit. This part of the thermostat is more for proof of concept and will be represented by a GPIO turning on.

2.6 **Tests Requirements**

The tests requirements will be done by myself, Jeremy Nicholson. I will test each and every individual module separately and thoroughly. After I am convinced it is working the way I have intended it to, I will begin to put the whole system together and start rigorously testing the system as a whole. Please see test plan for complete set of tests.

2.7 **Packaging**

³⁵₁₇ The system will be using the STM32 set of boards which use ARM cortex M4 CPUs and will be handling all the interactions from the peripherals and module.

³⁵₁₇ I plan on making nice and neat cases for each individual module using the 3D printer on campus.

2.8 **Environmental Requirements**

All modules must be kept indoors and within specified specifications of the STM32 boards. Since the light and fan modules deal with main voltage, please be cautious that this is HIGH VOLTAGE and putting a module near flammables is not a good idea, so make sure you place these

in nice and safe environments.

2.9 Power Supply Requirements

³⁵₁₇ All boards will be powered by ~3.5V in the form of 3 x AAA batteries.

³⁵₁₇ The light and fan modules require a wall plug to power on the light bulb and fan. This requires a power source of around 120Vac at 50-60Hz.

3. Glossary

Xbee – wireless communication module

TFT LCD – A thin-film-transistor liquid-crystal display

4. Estimate Project Costs

1 x STM32F4 board with TFT LCD	\$25
4 x STM32F3 board	\$11 x 4 = 44
5 x Xbee wireless modules	\$20 x 5 = 100
1 x light sensor	\$6
1 x servo motor	\$10
1 x thermostat	\$24
1 x fan (optional)	\$40
1 x light bulb	\$8
Other electrical components,	\$40
Wires, adapters	
Total	~\$300