# Initial Project and Group Identification Document

## Divide and Conquer 1.0


# Home Security and Automation System

**Group 14**

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# Project Motivation

Popularity of smart home systems are on the rise, but many are extremely expensive. We realized that the idea of a smart home already has many subsystems for monitoring activity, so we decided to combine an automated home system with a security system for an all-in-one interface. It will be comparatively low-cost to other automated home systems and include security functionality such as fire detection, front-door identification, and light management.

# Project Description

### Motion Detectors and Infrared Photodiodes

Two of the key features of our Home Automation System are safety and security. Infrared motion detectors will be able to detect when someone enters or leaves a room. This is essential for allowing users to know if someone is in their house and can provide a speedy reaction to burglary or other crimes. These sensors will be embedded into the doorbell to detect when someone is at the front door to allow recording of any visitors. They also act simply to communicate to the other portions of our system that someone is home to turn on lights or switch the air conditioning setting.

A fire detection system will be set in place by utilizing NIR photodiodes to detect high temperatures within a room. These photodiodes will operate at the peak blackbody emission of house fires, around 1.1 micrometers, and communicate to the central system when something in the room is emitting at this spectrum. This system has a much faster response time than smoke detectors, so the user will be able to react in a timelier manner.

The proximity of the motion sensors will be conical and limited to about ten to twenty feet, so several will be spaced in the same room. The photodiodes have a shorter proximity limited to around 2.5 feet for small flames and a much further range as the flame increase, so many more of them will be connected in a circuit for each room. This will ensure that all points of interest including heated appliances and electrical sockets are carefully monitored.

### Display

The display will be a touch screen display compatible with the chosen system controller. The interface will be no more than seven inches measured diagonally. There will be a sleep function on the display to conserve power when it is not in use. All configurable buttons, sliders, and text boxes of the web application will be compatible with the available touch screen and on-screen keyboard.

### AC Control

The system will need to be able to turn AC units on/off with the use of a relay installed at the AC controller. If possible, the system will also be able to act as an AC controller with the addition of a temperature sensor. User will be able to set up an AC schedule and (if applicable) Automatic AC through the use of the System Web Application

## Outlets

This System should be able to incorporate Smart Outlets through either direct GPIO manipulation to a modified outlet or by using the IP accessible wireless outlets already available in the market. The user should be able to label and turn these outlets on and off through the central hub or by the use of the LAN web interface.

## User Interface

Included with the system, a central hub and a web interface will allow users to manage and control the system. This central hub will be a local server connected to the various other components discussed before. It will act as a receiver for the data sent by them and a processing unit of such data. The web interface will be the main link between the users and the system. It will allow the user will be able to program the system to their requirements, see the data logs, and manage access to the system.

## Central Hub

Sensors and control interfaces will be connected to a microcontroller platform such as an Arduino or MSP430, which will simplify the process of making a direct connection between the hardware of the sensors and the central hub of the system. The microcontroller will in turn be connected to a more powerful microcomputing platform such as a raspberry pi upon which a control system and user-interface can be built in software. This component will be directly connected to the user's LAN, either via WIFI or via ethernet, and will host a lightweight web server which can be connected to by any computer on the network and implements password verification for access to the settings for the various connected devices. This solution offers a great deal of flexibility in regards to the number of devices which can be used to access and control the central hub of the system and also reduces the implicit workload of creating a user-interface, as an HTTP-Based solution will allow a wide range of devices to access the interface without the need to design a client-application for each.

The system should also allow utilization of the display mentioned above for in-person configuration, presenting the same interface and allowing for the same range of customization as is available to users in either computers on the network or via a connected mobile device.

# Project Specifications

**1. PCB Design**
   a. Dimensions (LxW): 4x3 inches
   b. Will receive power from a power supply

**2. Web Application/System Controller:**
   a. System should be small in size and its weight should not exceed 5 lbs.
   b. Will allow management of system
   c. Interface should be easy to use and intuitive
   d. Should be protected from unauthorized access

**3. Motion Sensors:**
   a. Will detect movement
   b. Will send HIGH signal when triggered to central system
   c. Range of around 15 feet.

**4. Thermal Sensors:**
   a. Will detect Fire, or Very High Temperatures (>500 Celsius)
   b. Will send HIGH signal when triggered to central system
   c. Must be able to distinguish between Fire and Body Heat
   d. Will have range of about 2 feet for small flames and higher for large flames.
   e. Can also detect exceedingly high temperatures before combustion.

**5. Camera:**
   a. Will capture images once doorbell is used
   b. This data will be sent to central system and stored
   c. Camera and Doorbell Button must be in the same housing.
   d. Housing should not exceed 5” in length or width

**6. Power:**
   a. Battery should last 12 hours on full charge
   b. Power should be conserved when not in use

**7. Door Lock:**
   a. Must have a key entry in case of power loss.
   b. Will work together with the camera

**8. AC Control**
   a. Voltage for AC Switch must be either 5 or 12 Volts depending on AC Unit
   b. Temperature sensor and Automatic Setting will be optional (Plausibility will be determined at a later time).

**9. Outlet**
   a. If using a wired connection, the Outlet should be modified with a 5V input relay
   b. Wireless Outlets must have an open source API available to allow the system to access the device through IP connection.

# Milestones

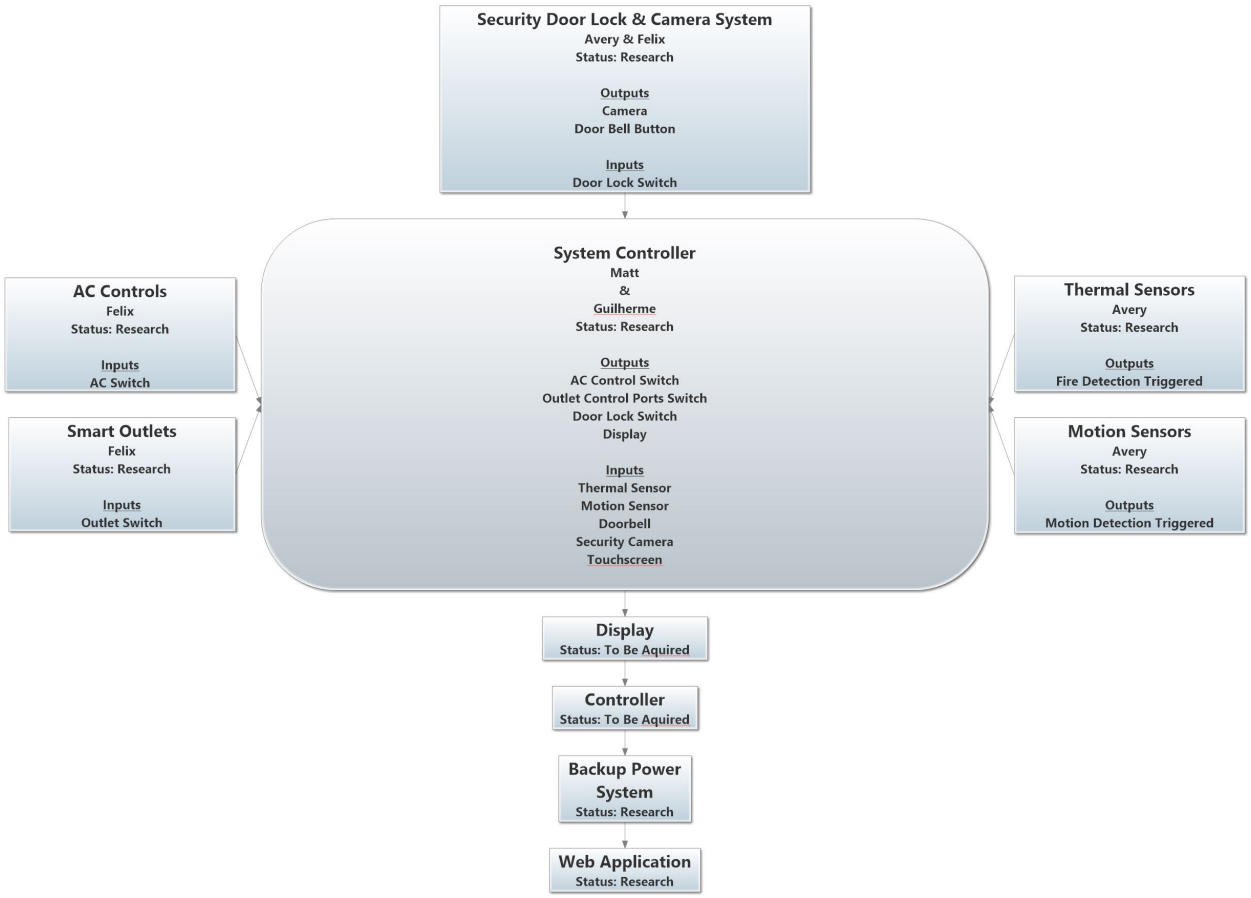
| Task | Start Date | End Date | Status |
|---|---|---|---|
| **Week 1** | | | |
| Formation of Group | 5/13/2019 | 5/17/2019 | Completed |
| **Week 2** | | | |
| Brainstorming | 5/19/2019 | 5/24/2019 | Completed |
| Initial Project Document | 5/21/2019 | 5/27/2019 | Completed |
| **Weeks 3 and 4** | | | |
| Meeting with Professor | 5/28/2019 | 6/7/2019 | In Progress |
| Table of Contents | TBA | TBA | Not Started |
| **Remaining Weeks** | | | |
| First Documentation Draft | TBA | TBA | Not Started |
| Final Draft | TBA | TBA | Not Started |
| PCB Design | TBA | TBA | Not Started |
| Acquire Components | TBA | TBA | Not Started |
| **Senior Design II** | | | |
| Build Prototype | TBA | TBA | Not Started |
| Test Prototype | TBA | TBA | Not Started |
| Code Research Code Development | TBA | TBA | Not Started |
| Final Presentation | TBA | TBA | Not Started |

# Budget

The project will be sponsored by the team members themselves. The following table provides estimates of the prices of the main components for the project.

| Parts | Expected Costs |
|---|---|
| Motion Sensor System | $10 |
| Thermal Sensor System | $25 |
| Micro Controller | $35 |
| Display Kit | $70 |
| Security Camera | $10 |
| PCB | $30 |
| Door Lock System | $20 |
| Outlet System | $35 |
| Backup Battery System | $30 |
| Web Server | $45 |
| Domain | $15 |
| **Total Cost** | **$325** |

# System Diagram



# Theoretical Layout