EE/MKT/FASC Collaborative Project

Spring 2014

Smart Sensor/Controller Systems

Product Overview

The product this semester is a device for sensing and controlling various aspects of a residence or small business. A homeowner or business owner can install this device and use it to sense various conditions such as temperature, moisture, amount of light, smoke, noise, etc. Based on these inputs the device may trigger an alarm, adjust the heating or cooling, turn lights on or off, notify the residents, or take any other actions that is needed.

It is likely that all of the functions provided by this device can currently be purchased as individual units such as smoke alarms, light timers, thermometers, burglar alarms and many others. The goal with this product is to build a unified system that allows the homeowner or business owner to integrate all these functions into a single unit. By combining the abilities of several devices it is hoped that a system can be built where the total functionality is greater than the sum of that of the individual components.

It will be up to the product development teams to determine what types of sensors and controllers they want to provide in their product. The results of the market research performed by the Marketing students should provide data as to what features consumers find attractive in the product.

Product Features

The EE/MKT/FASC product teams are free to design the product in any way they choose that achieves the goal of producing a system that meets the project requirements. This product is intended for installation in existing homes or small businesses, not for installation in new homes during their construction. This may affect your design decisions since it your customers may be less willing to run wires between devices if it means ripping walls apart to install the wiring. As part of the product design process, teams should consider some of the following goals for their product.

- Ease-of-use. You are developing a product that will probably be installed and used by non-technical people. It should be easy to set up and use and not require the user to call in an expert every time they want to make a small change in the configuration.

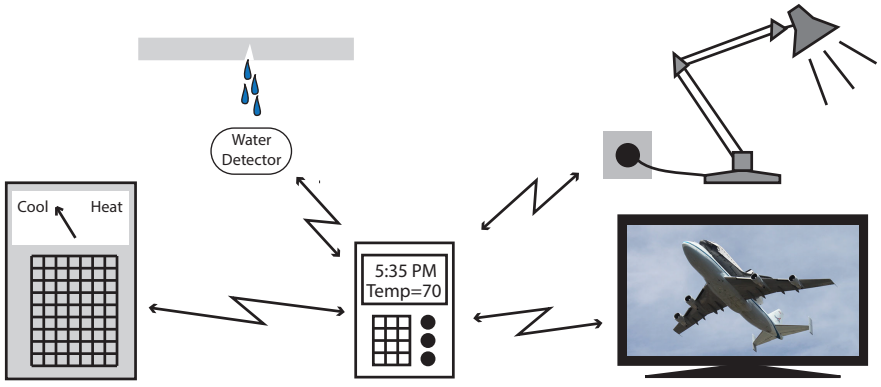

Figure 1: Smart system with various sensors/controllers

- Expandable. The user should be able to add more sensors or controllers to their system in the future without have to reinstall or reconfigure the entire system. Your company plans on introducing additional components for the system in the future but should do so in a way that does not require their past consumers scrap their existing system in order to incorporate them.
- Reliability. The product should be designed with the idea that once it is installed it may operate for many years without the owner making changes to it. What can be done during the design stage to produce a product that has a longer useful life than many consumer electronics devices?

The product teams are encouraged to explore any designs that they can dream up. Keep in mind the overall goal is to develop a commercially viable product which may or may not look like anything ever seen before on the market.

Product Requirements

The following are requirements for the product prototype that all teams must include in their design. Teams are encouraged to go beyond these requirements in terms of both additional features and the quantity of each feature. It is not required that every single feature that is claimed for the product be implemented in the prototype. Teams should plan to implement in their prototype about 80% of the features they claim for their product but should not make claims for product features that can not be implemented due to limitations on the available technology. Teams are not required to implement every product feature to the same extent or quantity as would be required in the final product. For example, if your product claims to be able to control 20 devices of some type, it is not required that the prototype be able to control all 20. Showing that it can control two or three, and is expandable to more, is sufficient. The cost analysis of the final product should reflect any claims made for it, not just what was implemented in the prototype

In the description below of the project, the terms "inputs" and "outputs" refers to whatever devices the product includes that senses conditions (the inputs) or does something to cause some action to happen (the outputs).

- The device should consist of a main controller unit that is linked to remote input and output units. In the actual product the connection between the controller and the remote units can be some type of wireless link. However experience in past semesters has shown the the wireless links can be difficult and expensive for the teams to work with so teams may be allowed to simulate a wireless link by using a wired connection. This will be discussed in more detail in EE459 class meetings.
- The system must include at least three inputs of different types (temperature, moisture, noise, motion, buttons, light, etc.) One of the inputs can be incorporated into the main controller if that is the optimum place for it. The others must be remote inputs that communicate with the main controller.
- The system must include at least three outputs of different types that do something as a result of the information provided by the inputs devices. These can be alarms, servo motors that move something, electrical outlets that are turned on or off, etc. One of the outputs can be incorporated into the main controller if that is the optimum place for it. The others must be in remote units that communicate with the main controller.
- At least one of the input or output components of the system must be new to the market in that it can not be found in competing products that are currently on the market.
- The main controller must be able to detect and notify the user when it can no longer communicate with a remote input or output device. This might be due to a broken communications link, a dead battery, or the remote unit itself may have become defective. A user should not think that all is well with his system when in fact an input or output unit is no longer working.
- If the product is designed to include wireless links between the controller and the remote units, the design must address the issue of how to prevent inadvertent interference with or from a neighbor's similar unit. The product should only communicate with wireless devices that it is supposed to be associated with.

- The controller must be immune to power outages in that the user should not have to take any action to put the product back into service after a power outage. For example if the controller has a internal time-of-day clock, then the clock must be able to continue to function during power outages so that it will know the correct time when the power is restored. All configuration data for the various inputs and outputs should also be retained through power outages. It is not required that the various outputs continue to operate if the controller loses power, however once power is restored everything should resume normal operation without operator intervention.
- The devices may not use the home's 120V AC power wiring for communication like some devices that have been on the market for many years. This requirement is primarily for safety reasons since we don't want students to have their prototypes connected to high voltages while working on them.

All teams are encouraged to go beyond these minimum requirements in order to make their product more attractive to consumers. Whenever possible, additional features selected for inclusion in the product should be included in the prototypes sufficiently to show that they can be implemented and would work as planned. Teams should always be aware of how additional features will affect the cost of their product and be prepared to justify the added cost. For example, a team may decide to add a module to their product to give it a wireless connection to the Internet, and then plan to use this to send messages to the user about various conditions. The cost of this module must then be factored into the cost of the product. Saying that you have added a $80 module to a project that is suppose to sell for $60 is not a good idea if you plan to make a profit.