USC Viterbi School of Engineering

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EE 459Lx - Embedded Systems Design Laboratory

EE 459 Project - Spring 2015

Smart Device for Recreation

Product Overview

The product this semester is a smart device for enhancing some aspect of a recreational activity. The choice of which recreational activity it is intended for, how it enhances that activity, and who it is intended for is up to the product development team. It should be a product whose primary purpose is to improve the enjoyment, safety, or quality of the activity, as opposed to something that gathers data during the activity for later analysis or evaluation. Some examples might be

- A device to warn bicyclers that a car is approaching them from the rear.
- Emergency alert device for hikers to notify rescuers if they get lost.
- An exercise assistant for helping the elderly keep active.

It is likely that all of the functions provided by this device can currently be purchased either as a standalone device or as apps for a smart phone. However for many recreational tasks using a relatively expensive phone may not be what customers want. The goal here is to design an effective product that will perform the tasks reliably but be cheap enough that the owner will view it as being expendable in case it gets damaged through normal use.

Product Features

The EE 459 product teams are free to design the product in any way they choose, and include whatever features they feel are needed, that achieves the goal of producing a product that meets the class requirements. The product can be designed for either personal use or for use by an organization such as a school or municipal recreation department who might issue them to participants in some activity, class or other event. It can be designed for any age group however the choice of which age group you are designing for will likely have a significant impact on the product. It could be something for children to use, or for parents to require their children to have with them. Or it could be a product for the elderly to help them with recreational and other health beneficial activities.

The following are a sample of some of the criteria your team should consider when selecting your product and deciding on what features to include in it.

Benefits –The user should feel that using the product makes his or her participation in the chosen activity better in some way such as safer, more fun, more memorable, healthier, etc. Or it could simply make possible some activity that was not possible to do for some reason before they purchased your product.

Ease-of-use – You are developing a product that will probably be used by people who are primarily interested in doing something else other than spending time trying to figure out how to operate your product. While it may be acceptable to require some time to initially figure out how to make it work, from that point on it should be simple and intuitive to use so the user can make full use of it without having to constantly be referring to an owner's manual.

Reliability – The product should be designed with the idea that it will primarily be used during some physical activity so durability and reliability are important. For example if you design a product for use by a bicyclist, can your project survive if the cyclist take a fall and the bike bounces around on the pavement? They shouldn't get up, dust themselves off, and say "Well, I'm OK, but that thing I paid $100 for is destroyed."

Cost – How much are will it cost to add your features to the product, and are the consumers willing to pay for whatever your product adds to their recreation experience? This will likely vary widely depending on what recreational activity your product is targeted at.

You can incorporate any available technology you wish to use into the product (GPS, Bluetooth, RFID, WiFi, etc.), but any technology you use should meet two requirements.

- The cost of the product must reflect whatever technology you include in it.
- Any added technology must be used in some way. For example, don't add a GPS sensor to the product and market it as having "GPS capability" but admit during your final presentation that you really never knew what you were going to use GPS for in the product.

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. The cost analysis of the final product should reflect any claims made for it, not just what was implemented in the prototype

Some of the requirement listed below have been added to the product simply to force teams to build a more challenging product that makes use of a certain amount of technology. In some cases teams may have to add features or capabilities to their product simply to meet these minimum requirements. This is to avoid a situation where, for example, if the class product was to build a residential burglar alarm, a team just paints a sign that says "Guard Dog on Duty" and says that's their product.

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 product must include at least three inputs of different types (temperature, moisture, sound, motion, light, position, buttons, etc.), and at least two outputs of different types (alarms, display devices, motors, etc.) that do something as a result of the information provided by the inputs devices. As an alternative, you can reverse these requirements and have at least two inputs and at least three outputs.
- 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.
- If the product consists of multiple devices that communicate via a link of some sort the main device must be able to detect and notify the user when it can no longer communicate with a remote 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 product when in fact an remote unit is no longer working.

- If the product uses wireless links between the main device and one or more remote units, the design must address the issue of how to prevent inadvertent interference with or from another similar unit. The product should only communicate with wireless devices that it is supposed to be associated with.

- The product should be immune to loss of power as when the battery loses its charge. It should retain any settings or data through a power outage so that it returns to its previous state when power is restored. For example, most bicycle computers that track a rider's speed and distance covered will lose the odometer (total miles traveled) reading if the battery goes dead. The manuals often give instructions to record the odometer reading before changing the battery, and then how to restore the setting once the new battery is installed. This is a nuisance to do and it should be possible for the device to remember the odometer data even when the power is lost. The same problems can occur if he product was not used for some time and the battery went dead. The owner should only have to recharge or replace the battery to have it back to the condition it was previously.

- The same would apply if the product has a internal time-of-day clock. 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 product loses power, however once power is restored everything should resume normal operation without operator intervention.

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 supposed to sell for $60 is not a good idea if you know your consumer will not pay the associated increase in price.