

ECE 411 Industry Design Processes: Assignment #3

Due on Monday, October 27, 2014

Faust 2:00pm

Team: To8

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<https://github.com/DroningOn/ECE411>

**Project Design Specification (PDS)
for
Wireless Apparatus for Real-Time Classroom Feedback**

**Version 1.0
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Table of Contents

- [Introduction](#)
- [Purpose of the Product Design Specification Document](#)
- [Project Overview](#)
- [Requirements](#)
 - [Functional Requirements](#)
 - [Performance Requirements](#)
 - [Economic and Marketing Requirements](#)
 - [Power Requirements](#)
 - [Health and Safety](#)
 - [Maintainability](#)
 - [Operational Environment](#)
 - [Usability](#)
- [REFERENCES](#)

Introduction

Wireless clickers are used in classroom settings to facilitate real-time feedback between professors and their students. Such devices are currently available on the market today. However, none of these devices are able to meet the cost and performance requirements in order for them to become practical for use in ECE 411 at Portland State University. This project aims to address those needs in a cost-sensitive design environment.

Purpose of the Product Design Specification Document

The purpose of this specification is to describe the scope of the project and to verify that it meets the requirements of our intended audience. In order for the project to be deemed successful, it shall meet all of the requirements outlined in the requirements section of this document subject to the “Must” weighting. Additional features listed as “Should” and “May” are deemed desirable but do not constitute a required project specification. The scope of this project is outlined below.

In Scope

This document addresses the design requirements directly related to the design of a wireless classroom feedback system to facilitate real-time feedback between professors and their students.

- Design a real-time feedback system for data polling
- Design an integrated PCB antenna solution for wireless communication with a central hub.
- Provide a user-friendly interface that accepts user inputs and relays them to a central hub.
- Provide a software GUI that collects user data and presents it in a meaningful way
 - Example: Bar graph, Pie chart, activity over time, etc.
- Format data for export as standard csv or tab delimited values

Out of Scope

The following items are outside of the scope of the initial project and may be addressed by subsequent practicum design projects.

- Verify all FCC regulations pertaining to short-range wireless communication devices (47CFR20) are met.
- Verify all safe operating conditions pursuant to ANSI Std. C95.1 are met.

Project Overview

This project addresses the specific need for a cost-sensitive real-time feedback system in ECE 411. The system is comprised of a central hub and multiple hand-held user feedback devices. The central hub initiates communication following a 'master' run mode command. Users may then provide feedback using one of four inputs on the held-held device. Each of the four inputs is able to provide the user with feedback indicating which input was received. User inputs are conveyed wirelessly to the central hub where the data is collected and analyzed. A simple GUI organizes the information and presents the 'master' user with the results.

User Characteristics

Two primary types of users are identified in the following lists to better describe the intended target market.

- Professors
 - Professors shape the flow of the classroom experience and are ultimately in charge of the central hub. Professors use the system to initiate simple communication from which they can receive student feedback.
- Students
 - Students are users that provide feedback in response to a predetermined stimulus given by the professors. One specific example would be student response to a particular quiz question.

Assumptions

- Users are familiar with the ECE 411 practicum design guidelines
- System is used in standard classroom setting
 - System shall not be exposed to outdoor environmental conditions

Constraints

- Use a two layer PCB that is between 1 and 16 in², with no side of the board being less than 1 inch or more than 12 inches
- Must use components that can be hand soldered or easily soldered in a crude reflow oven
- Must be completed in limited time frame ~8-10 weeks on a minimal budget

Requirements

The requirements outlined below are intended to identify all important requirements pertaining to the real-time classroom feedback system. These requirements have been separated into eight distinct categories as is often used for a large project spanning multiple departments. These categories ensure that each department has a clear understanding of the project specification and how it contributes to the successful completion of all deliverables.

Functional Requirements

Table 1: Functional Requirements

Req#	Requirement	Priority	Station
I.1	Have one or more inputs or sensors	Must	Satellite
I.2	Have one or more processing modules which control some of the outputs based on the inputs	Must	Satellite/Hub
I.3	Communications shall utilize one of the unlicensed ISM bands (400 MHz, 900 Mhz, 2400 MHz)	Must	Satellite/Hub
I.4	Have an indication that input has been received.	Must	Satellite
I.5	Integrated PCB Antenna	Should	Satellite
I.6	Have means to identify particular unit.	Should	Satellite
I.7	Ability to connect to PC via USB for data display and logging	Must	Hub
I.8	Log and display data on an external system	Must	Hub

Performance Requirements

Table 2: Performance Requirements

Req#	Requirement	Priority	Station
2.1	Must be able to receive up to 100-500 votes per transmission	Must	Hub
2.2	Less than 0.1% loss of votes per transmission	Must	Satellite/Hub

Economic and Marketing Requirements

Table 3: Economic and Marketing Requirements

Req#	Requirement	Priority	Station
3.1	Should not use non-standard components	Should	Satellite
3.2	Extended price per unit at 100 units must be less than \$15	Must	Satellite

Power Requirements

Table 4: Power Requirements

Req#	Requirement	Priority	Station
4.1	Hub shall utilize power available via USB	Must	Hub
4.2	Satellite battery lifetime shall last, at minimum, for one academic quarter under normal operating conditions.	Must	Satellite
4.3	Peak current draw shall not exceed 125mA	Must	Satellite
4.4	Satellite shall return to low power mode after communications are complete to maximize battery lifetime	Must	Satellite

Health and Safety

Table 5: Health and Safety

Req#	Requirement	Priority	Station
5.1	The system shall not expose humans to unhealthy levels of electromagnetic radiation as deemed by FCC guidelines	Must	Satellite/Hub

Maintainability

Table 6: Maintainability

Req#	Requirement	Priority
6.1	Code and engineering documentation must be placed under revision control.	Must
6.2	Project related decisions and engineering logs shall be documented on a weekly basis	Must
6.3	Documentation may be presented in the form of weekly progress reports (WPRs)	May
6.4	Progress reports may be submitted by email	May
6.5	Documentation and engineering logs may also be maintained through the use of a wiki.	May

Operational Environment

Table 7: Operational Environment

Req#	Requirement	Priority	Station
7.1	Tx/Rx stations shall be verified to operate under 1 atm at room temperature similar to intended use.	Must	Satellite/Hub

Usability

Table 8: Usability

Req#	Requirement	Priority	Station
8.1	Users ¹ should be able to use the system without training or product documentation.	Should	Satellite

¹ See the “Users” section of this document for more information about the intended target user.

Manufacturability

Table 9: Usability

Req#	Requirement	Priority	Station
8.1	Must have at least 25% surface mount components.	Should	Satellite
8.2	Must be possible to assemble by hand.	Must	Satellite

REFERENCES

- 1) FCC , Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation ET Docket No. 93-62, 1996.
- 2) Ralph Ford and Chris Coulston, Design for Electrical and Computer Engineers, McGraw-Hill, New York, NY, 2008.
- 3) CDC, Unified Process Project Templates, “Product Design”, www2a.cdc.gov/cdcup/library/templates/default.htm#.VE5ot_nF8zs.