

**Senior Design Project Pre-Proposal
Michigan State University
College of Engineering**

Dispenser Cup Content Detection

Design Team 8:

Gao Xin

Daniel Sun

Connor Grossman

Hongyi Shen

Daniel Gomez

Sponsor:

Whirlpool

Facilitator:

Professor Dean Aslam

Executive Summary

Whirlpool has challenged design team eight with the task of improving the dispenser cup from last semester's project. These improvements include: Integrating independent power source for the dispenser, communication between the appliance and dispenser without the use of harnesses or contact pads and user friendly LEDs to guide the user on which dispenser cup needs to be filled. LEDs, a microcontroller and cup content sensors must be supported by the dispenser. Our final product, the functional dispenser, will have to be robust in high humidity and high temperatures. In addition, the non-contact system that provides communication and power needs to be interchangeable with other features and improvements in the future.

Technical Section

Customer Requirements

The customer has a functional dispenser cup with content detection that uses LEDs and sensors to detect which dispenser cup has a liquid or powder in it. From there they wish to determine the actual substance based on which cup was filled. To make the appliance lower cost and more efficient, the customer has asked us to implement wireless communications between the appliance control unit and the dispenser. The dispensers are mostly used in washing machine appliances which tend to vibrate a lot, making wireless communication a key factor for the dispenser and appliance. Another task is to implement LED's to light up with certain cycles of the washing machine so the user knows which cup needs to be filled in order to perform that cycle. Wireless power is another feature that must be implemented in the dispenser. All of this is to make the dispenser physically independent from the appliance control unit so that the dispenser can be removed and cleaned if needed. Overall there are three task we need to accomplish:

1. To have the appliance control unit tell the dispenser which cups need to be filled and have it tell the user via LEDs
2. To power the dispenser independently
3. Wireless communication between the appliance control unit and the dispenser for future features of the system

Background Research

Whirlpool Corporation is one of the largest washing machine manufacturer. It's headquartered in Benton Charter which is a township in Michigan State. The Company is founded on November 11 in 1911. Actually at very beginning, it is a small company produced electric, motor driven wringer washers. With the science and technology develop rapidly, most family choose to equip an washing machine at home instead of doing laundry outside or washing by hand. So the rigid demand of washing machine increase rapidly. Whirlpool also growing fast and become one of Fortune 500 company which has annual revenue of about 19 billion dollar and they have more than 70 manufacturing and technology research center in the world. There are also many washing machine on market. So how to wash the cloth clean is no longer a hard problem for manufacturer. However the new problem also came up. How to use the least energy to wash the cloth clean is a new challenge for manufacturer. So how to use the energy efficiently and to be environmental friendly are two big problems for manufacturer. In addition, with the fossil energy facing sufficient, the government and many environment protection organizations are also very care about it. Energy Star is an international standard for energy efficient consumer, it was created in 1992 by Environmental Protection Agency and the Department of Energy. it aims to promote the manufacturer to design the product more energy efficient. we can see the Energy Star label on most of whirlpool product on the market. The label shows how much energy it can save every year. For the customer, they take this into their consideration when they choose the product. This is not only for saving energy, but also for paying less on energy bill. So many company like whirlpool are willing funding the research to find some economically feasible way to reduce energy cost.

Design Specifications

The design of the Whirlpool smart dispenser cup needs to be able to detect liquid levels and indicate low level warnings through lightening LEDs. It also needs to meet the requirement of being wirelessly rechargeable and be controlled intelligently by the user.

There are two applications of LEDs. First of all, the LEDs will be used as detector to measure the amount level of pre-wash detergent. Secondly, the LEDs are able to send warning message by flashing to remind the user of filling certain cups.

The dispenser is independent from other parts of the washing machine and it has its own power system. The independent power system makes the assembly and removal of the dispenser easier, so the dispenser is completely independent from the appliance control unit. The cup is able to be removed from the appliance and can be cleaned.

Proposed Design Solution

Taking all the client specifications and concerns into consideration and taking into account the time limit, design team 8 has come with what we believe is the best design.

First of all, the design will revisit the sensors used in last semester design, using the same sensor technology, this is the LED coupled with a photo sensor. While the idea will remain the same some of the components will be replaced to get a better performance. One of the improvements the team aims to meet is using white LED instead of the red LED already used, the white LED would provide with wavelength emission that is optimally resonant with the photosensor. Another improvement would be implementing a band-pass to eliminate the ambient light. The ambient light can change the wavelength received by the photo sensor, so reducing the ambient light can increase the efficiency of the sensors.

The second part of the design is the wireless communication element. The dispenser has to know what cycle or washing machine function has been selected by the user. Then, this information will be transmitted to the microcontroller in charge of the LEDs and show the user which cups to fill. To solve this the team has decided to use a microcontroller with a wireless chip. Not only would this microcontroller be in charge of the wireless communications between the input of the appliance and the dispenser cups, but it would also allow the team to control the LEDs in the system.

The last specifications the design needs to meet would be that the dispenser cup has to receive power from the appliance without using contact pads between them, this is to make it easier for the user to remove the dispenser and clean the cups. For this design the dispenser cups would be self-powered using solar cells. These solar cells would charge a battery, which in return, power all the necessary components.

The last part of the design, consist in the GUI. This GUI would allow the user to select the cycle he desires which would produce the input for the entire system. It will also show the user the contents of each cup.

Risk Analysis

One of the risks that this project poses is the use of wireless charging or power. Due to the fact that power and communication between the dispenser and appliance control unit must occur without any contact points between them. The team has chosen to use a rechargeable battery to support the design. Using the concepts of Electromagnetics, the design could use a transmitter from the power source and a receiver in the design to charge up the battery. However the distance between the transmitter and receiver should not be too far apart and is possibly where the design could have some issues.

Another risk for the design is the temperature issue. Whirlpool has given us information to test the device from 0 to 70 degrees celsius. From the information given to the team, there might be a problem with the resistors used within the design. The resistor value could vary with temperature and this could potentially cause a seriously problem to the circuit and the whole system.

Project Management Plan

Personnel Task

Daniel Sun

- Team Manager

- Writing individual sections of reports

- Research on Solar charging

Connor Grossman

- Sensor research and design

- Band pass filter research and design

- Document Preparation

- Writing individual sections of reports

Daniel Gomez

- Lab Coordinator

- Writing individual sections of reports

Hongyi Shen

- Presentation Lead

- Writing individual sections of reports

Gao Xin

- Web Manager

- Writing individual sections of reports

Resources

The design team for the dispenser cup project had access to many resources through the Electrical and Computer Engineering Department (ECE). These resources included conference rooms, ECE shop, ECE laboratories. The ECE shop provided parts that the design team used to build prototype. The ECE department also provided a variety of different software programs. The ECE department provided tools to create prototypes and measure data and also test our prototypes.

Proposed Schedule

Meet up with facilitators and sponsors to verify and further detail the description of the project.

begin: 1/12/2015

Completed: 1/28/2015

Obtain the Model from Previous semester.

begin: 1/12/2015

Completed: 2/1/15

Complete background research and select the approach to the design.

begin: 1/12/2015

Completed:

Complete working on the Proposal

begin: 1/19/2015

Completed:

Complete Team web page

begin: 2/2/2015

Completed:

Complete GANTT chart

begin: 2/2/2015

Completed: 2/6/2015

Complete page for Design Day Program

Begin: 2/9/2015

Completed:

Practice Oral Proposal Presentation with Facilitator

Begin: 2/9/2015

Completed:

Complete oral presentation

begin: 2/9/2015

Completed:

Complete Final Proposals

begin: 2/16/2015

Completed: 2/21/2015

Complete Design Day Booklet Brochure

begin: 2/23/2015

Completed:

Complete Prototype Demonstration

begin: 2/2/2015

Completed:

Complete Final Prototype

begin: 3/16/2015

Completed:

Complete Final Report

begin: 3/16/2015

Completed:

Complete Team Design Issues paper

begin: 4/6/2015

Completed: 4/11/2015

Complete Design Day

begin: 1/12/2015

Completed: 5/1/2015

Projected Project Cost

Microcontroller

EZ-2500

LEDS

white/red/blue/green approximately 8

3d Model box to hold microcontroller and battery

Solar Cell

Photo-transistor