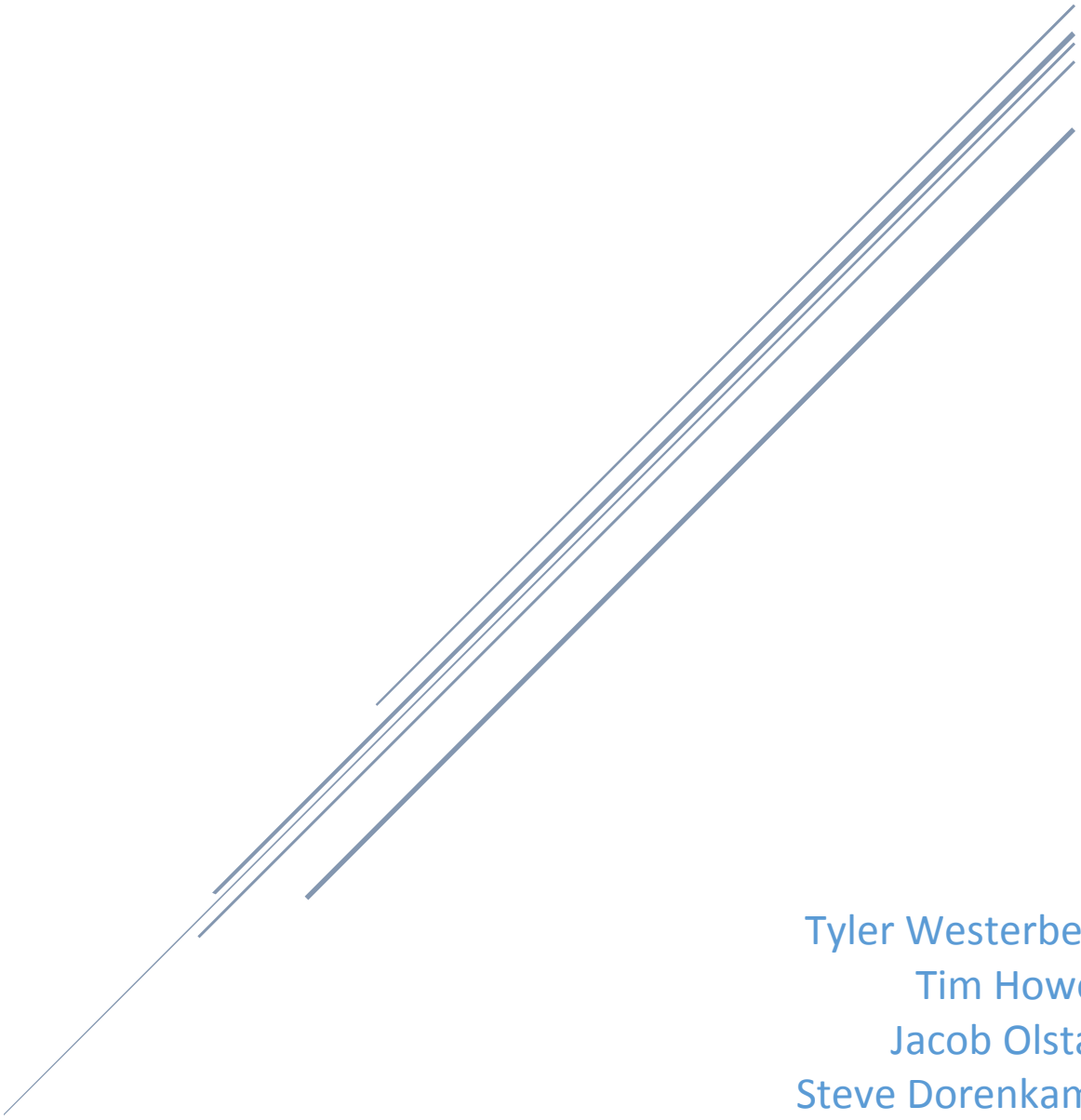
IVEND – INFRARED DETECTION

Team Dec15-10

with Dr. Wang and Fawn Engineering



Tyler Westerberg
Tim Howell
Jacob Olstad
Steve Dorenkamp
Seth Schmidt

Table of Contents

Introduction

Fawn Engineering Co. currently uses iVend Product Detection to indicate when products have been successfully dispensed in one of their machines. Currently, the system is experiencing intermittent times iVend fails to operate as required, resulting in the machine vending an additional product. Some of Fawn Engineering's designs are currently used with high cost items, which have resulted in significant losses for their customers. We have therefore been asked to redesign the current system to alleviate the problem.

Problem Statement

Fawn Engineering currently has a system to detect whether or not a vending machine has vended an item. The current design will occasionally miss a vend resulting in two items being vended. The goal of this project is to design a replacement system that will reliably detect when objects are being vended.

System Block Diagram

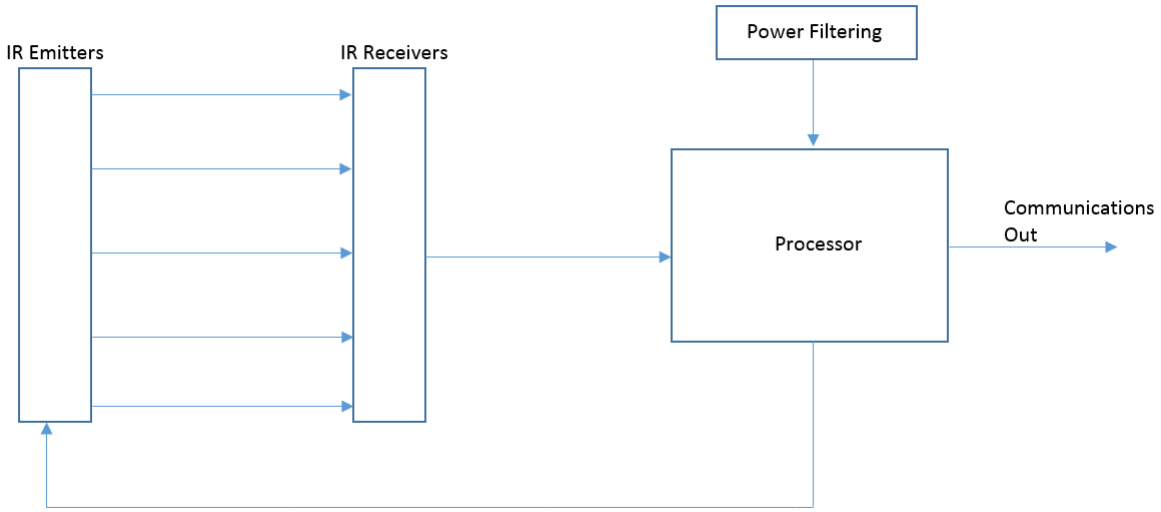


Figure 1 – Hardware Block Diagram

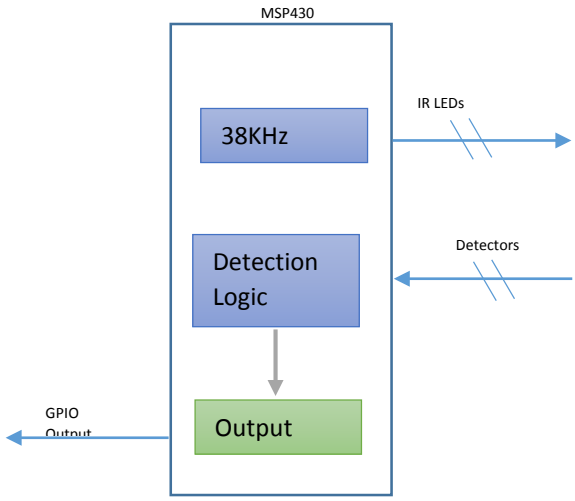


Figure 2 – Firmware Block Diagram

Proposed Solution

The approach we have decided to take is to alter the current system with a narrow band LED, specifically a 50-degree emitter-viewing angle. We believe the change to a 50-degree viewing angle, from the current 120-degree viewing angle, will cut down on reflection from the sides of the tray opening. The strengths of this design would be the short amount of time it would take to implement and test the new design, with virtually no increase in cost. Short falls of this design would be potential gaps between the LEDs and the possibility that the lower viewing angle will still have some reflective issues. The trade off of taking this approach is if the concept does not work as desired, we will be losing design time for an alternative approach.

Design Alternatives

- Power Averaging

  This solutions would average the power that makes it to each detector. When an object would pass through the matrix the average power would fall allowing for detection of the object. This solution was passed on due to increased complexity and variability in detectors due to manufacturing and temperature.

- Staggering LEDs and Detectors

  This solution would place LEDs and detectors on both sides of the bin. This would cut down on the total reflections internally and lead to a greater chance of detection when objects are close to one end or the other. This solution was passed on because of the increased cost associated with having to support additional wiring to connect the emitter board to the main board.

Requirements

Functional requirements

- The unit shall be capable of detecting an item in its matrix.
    - Objects may be as small as a standard zip tie.
- The unit shall be capable of communicating the event an item is vended.
- The unit shall use a voting system to detect an item.
    - Voting shall give priority to sensors and LEDs away from the walls of the system.
- The unit shall be capable of detecting an error during startup.
    - Error conditions will be communicated back to vending machine.

Specifications

- Unit shall be able to detect an object as small as a zip tie.
- Unit shall communicate an object detection by holding communications line low for at least 150ms.
- Unit shall have a visual indication of when an object is detected.
- Unit shall fit in the same form factor as existing product.

Test Plan

Once a prototype is developed it shall be placed in the machine for testing. The initial test will be done with a grid and zip tie to see if any holes exist. Once the prototype passes the initial test, products will be dropped through and results recorded. A variety of products both those that have had issues with reflection and products that have not will be used. Throughout the testing the units communication line will be monitored to insure it functioning as expected.

Work Plan

Resource Requirements

- Vending machine
- Original design documents
- PCB's
- IR LEDs and detectors
- Microprocessor
- Wires
- Power Supply
- Test jig

Deliverables

First Semester

- Testing of original system completed and have a complete understanding of the problems of the current system by May 2015.

Second semester

- Final prototype ready for approval by December 2015.

Timeline

Spring 2015 (First Semester)

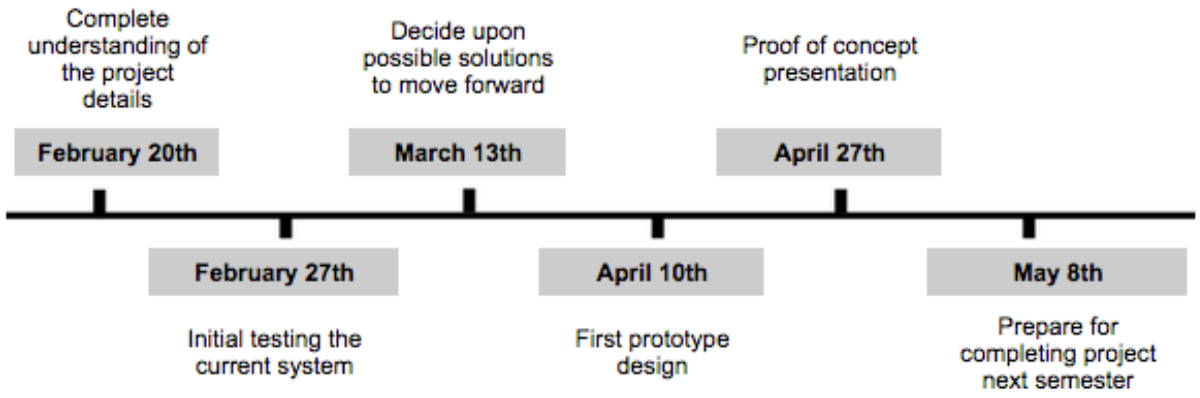


Figure 3 – Timeline for Spring Semester

Fall 2015 (Second Semester)

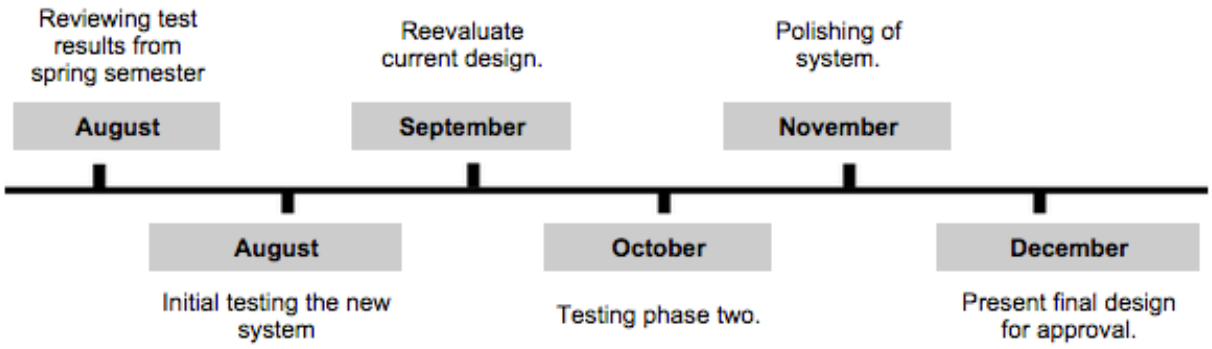


Figure 4 – Timeline for Fall Semester

Risk

- **Narrow band LEDs:**

  The narrow band LEDs may not sufficiently reduce the amount of reflections in the system. If this is the case a new solution will have to be sought.

- **Testing:**

  Due to the fact that the problem is intermittent and the number of configurations that are present it is possible that an initial round of testing may not show problems.

Feasibility

While this project does present some interesting design challenges such as how best to deal with the reflections around dropped products we feel that the project is very feasible.