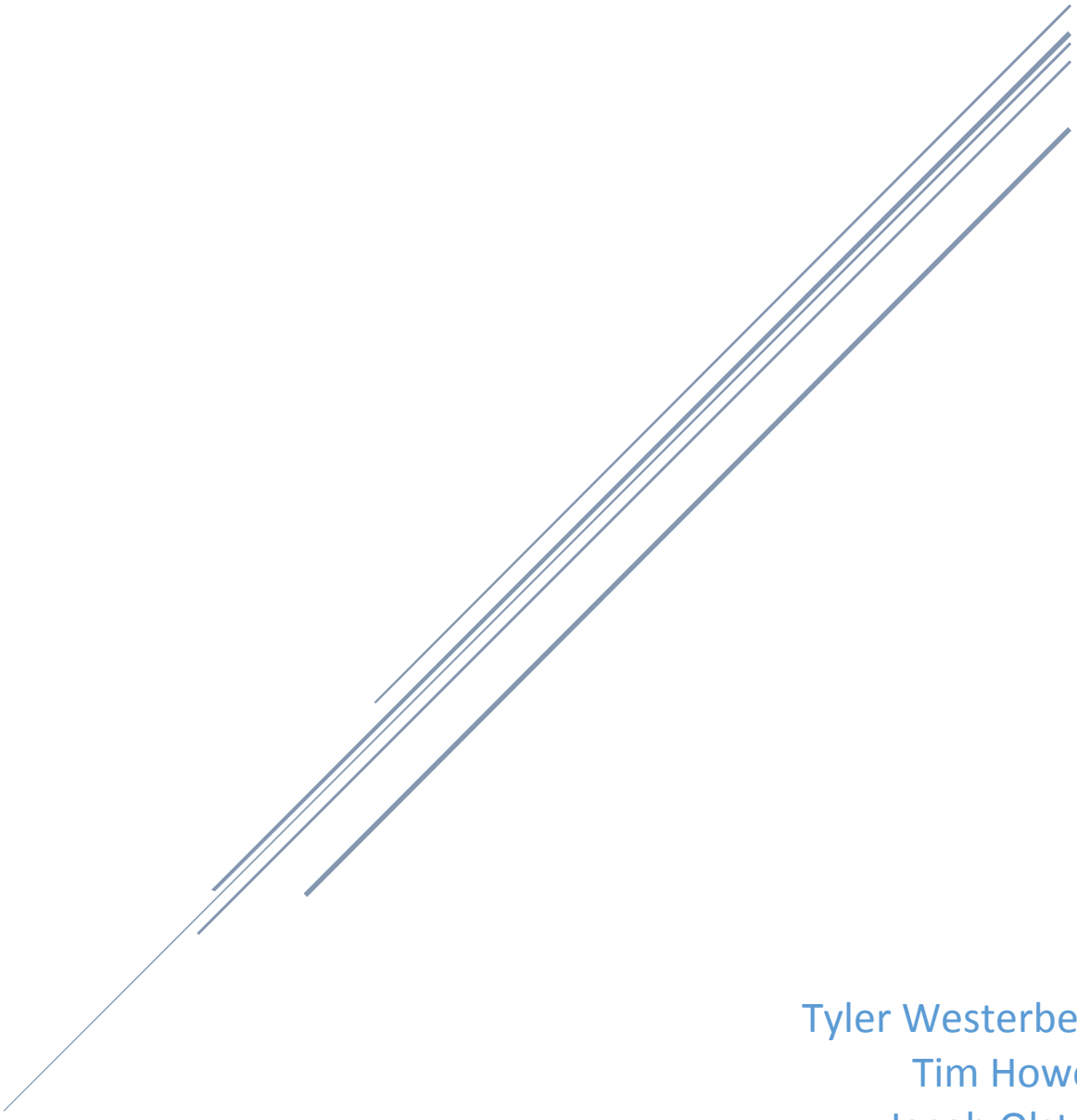
IVEND – INFRARED DETECTION

Team Dec15-10

with Dr. Wang and Fawn Engineering



Tyler Westerberg
Tim Howell
Jacob Olstad
Steve Dorenkamp
Seth Schmidt

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Introduction

Fawn Engineering 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

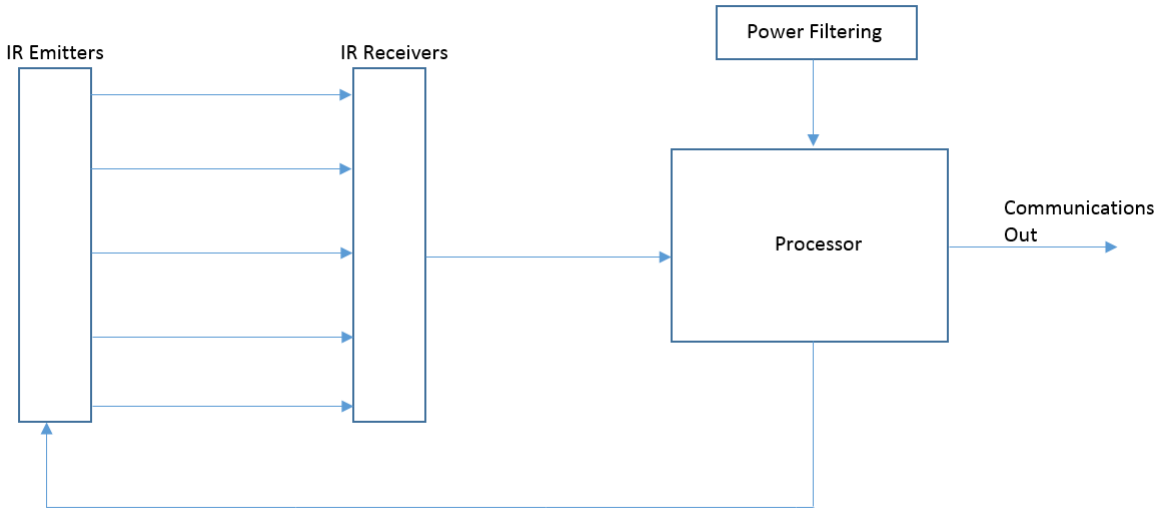

Figure 1 – Hardware Block Diagram

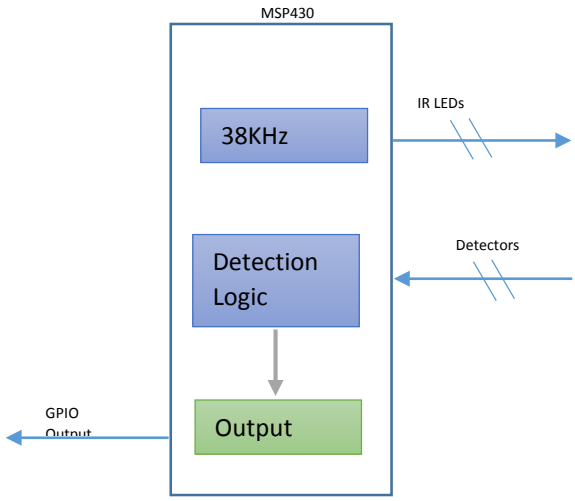

Figure 2 – Firmware Block Diagram

Proposed Solution

Our initial proposed solution was as follows:

> *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 tradeoff of taking this approach is if the concept does not work as desired, we will be losing design time for an alternative approach.*

After continued testing we have determined that this solution would not give us the results we were looking for. We continued testing the current system and were able to determine that the reflections were not the main source of the problem. The results we were getting were equally as poor, no matter if the iVend was in the machine or out in the open (where there would be no reflections). While probing the system we discovered that if the object was directly in the line of sight of the emitter and detector, it would be found every time. If it was outside of the line of sight there was a much better chance of it not being detected. We also discovered that if we added extra resistance before the LEDs, therefore lowering their intensity, we would get slightly better results. With these two ideas in mind we are going to move forward with the plan to add extra emitters and detectors, to increase the items caught in the line of sight, along with lowering the intensity of the LEDs.

Design Alternatives

- Power Averaging

  This solution 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

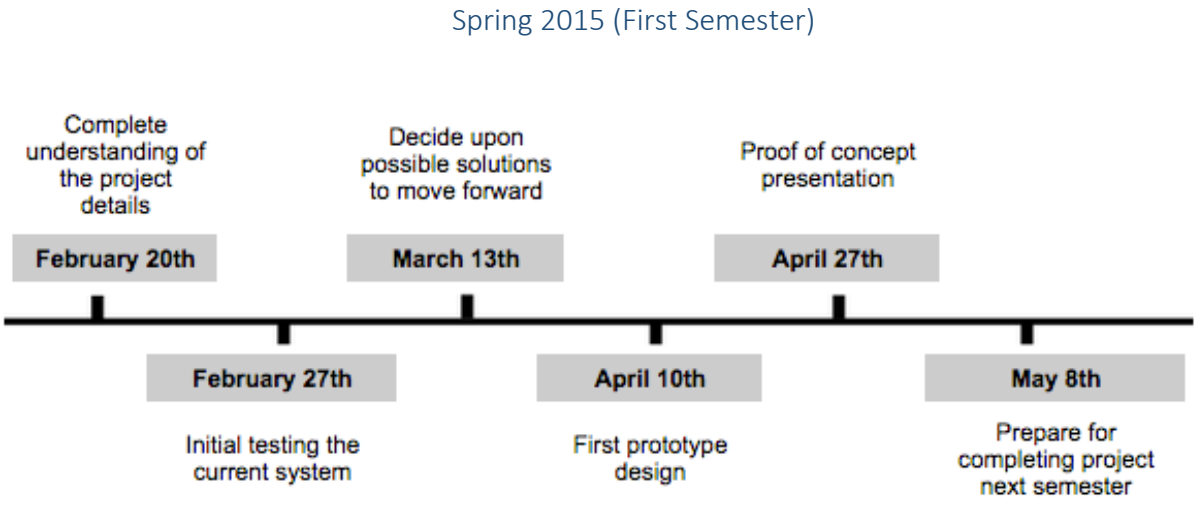

Figure 3 – Timeline for Spring Semester

Fall 2015 (Second Semester)

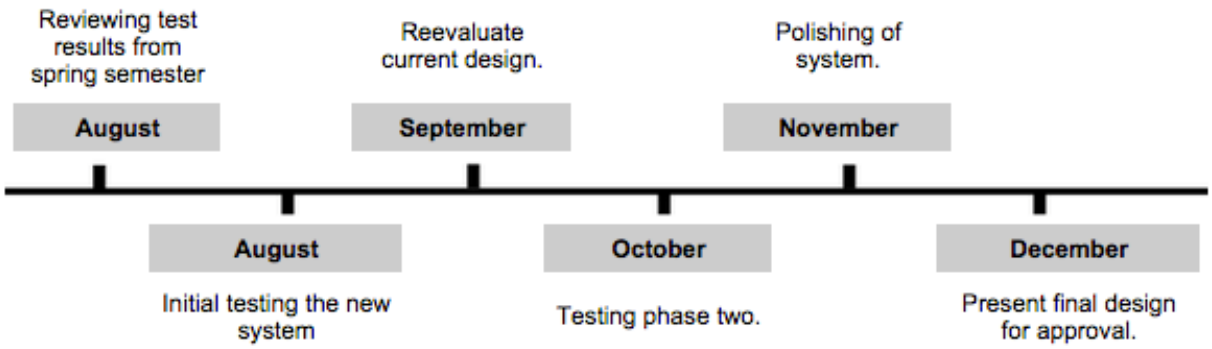

Figure 4 – Timeline for Fall Semester

Risk

- **Time Constraint:**

  Due to the amount of time we have, we will have to move quickly in the design process. If our first design does not work as desired, we will have to work fast to redesign the system to fix any problems.

- **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 flaws of the dropped products we feel that the project is very feasible.