Design Project 2:
Xerox Digital Printing System
Stack Quality

The Pennsylvania State University
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Team 3
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TECHNICAL REPORT

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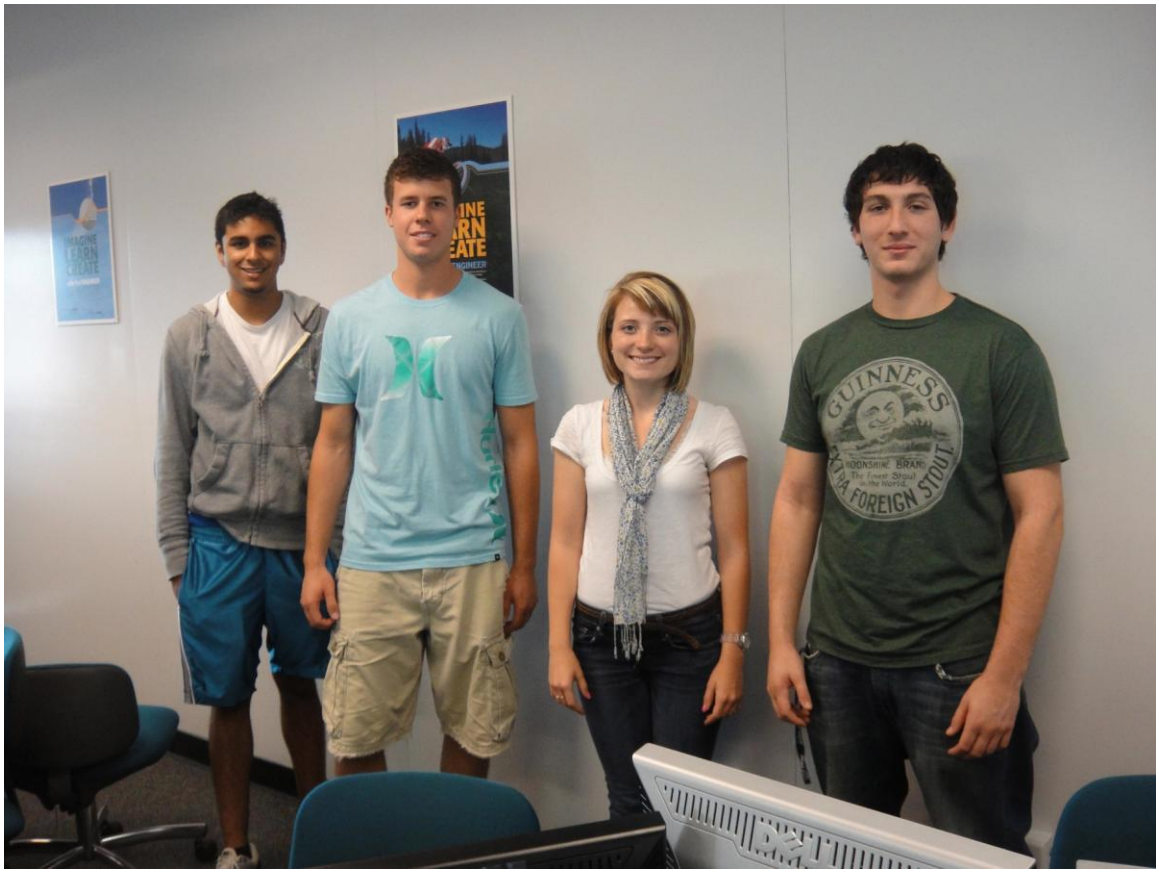
1.0 Abstract

This project is based on Xerox's specifications for a device created to measure the quality of paper stacked after it has been printed in the iGen4 digital production press. The focus of this project is specifically Xerox—they are the only customer. The goal is to make a product that meets all the requirements presented by Xerox in a cost effective manner. The product should have the ability to determine good stacks from bad stacks, but the product should also be cheap to make. The final product will meet the product specifications set by Xerox.

Table of Contents

1.0 Abstract	2
2.0 Meet the Team	4
3.0 Introduction	5
4.0 Mission Statement	6
5.0 Customer Needs Analysis	7
6.0 Generated Ideas	9
7.0 Final Product	10
7.1 Costs	11
8.0 Conclusion	12
9.0 References	13

2.0 Meet the Team



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3.0 Introduction

The objective of this project is to design a device that will qualitatively measure the stack quality from papers printed from the Xerox iGen4 digital printing press. After examining the specifications for the device given by Xerox, the team began brainstorming. We first looked at what the customer needs, as determined by the customer needs statements. This allowed us to plan our device according to what the customer wanted. Since Xerox is the only customer, we only have to align our plans with their needs.

From the needs statements, we knew the product had to be able to register when bad stacks are formed (as determined by Xerox) and it had to be cost effective. This lead to several ideas, all of which could meet at least the first requirement. However, some of the ideas could only meet one requirement, and some ideas could work better than others, but in order to satisfy the customer, both requirements must be fulfilled to the fullest extent.

We picked an idea that can measure the quality and will be cost effective. The final design will function as required, is cost effective, and will satisfy the customer's needs.

Goal Statement: To design a device that can qualitatively measure the quality of a printed stack for the Xerox iGen4 digital printing press.

4.0 Mission Statement

This device is for Xerox and their iGen4 digital printing press. It qualitatively measures the stack quality of 200 sheets of printed paper, and it's cost effective. The device is cheap, good quality, and easy to install in the printer. Our goal is to make the device to meet the needs of the customer and do the job as stated above.

Key features: LED lights, photo cells (light sensors)

Estimated cost: $32.01

- 8 photocells
- 8 LED lights
- 1 battery
- 16 Resistors

5.0 Customer Needs Analysis

Xerox is the only customer for this project, so their needs are the only needs considered. They clearly defined their needs and they gave detailed specifications for what they wanted.

Need	Need Statement	Objective Statement
All sheets in the stack cannot be offset from the bottom sheet in the stack by more than 5 mm in any direction.	Detect 200-sheet stack with no more than 5mm offset in any direction.	The device should detect a 200 sheet stack with no more than 5 mm offset in any direction.
A good stack of 200 sheets with a regular set offset of 5 mm every set (50 sheets) in the x-plane and no set offset in the z-plane.	Detect 200 sheets with regular 5mm offset every 50 sheets in the x-plane. Detect 200 sheets with regular offset with no set offset in the z-plane.	The printer will be able to detect a correctly made 5 mm offset ever 50 sheets in the x-plane, and detect no offset in the z-plane
Within a set of 50 sheets, all sheets in the stack cannot be offset from the bottom sheet in the set by more than 5 mm in any direction.	Within the set of 50 sheets in the offset stack detect any sheet with more than 5mm in any direction.	The printer will detect if any stack has more than a 5 mm offset in any direction.
A bad stack of 200 sheets with set offset of 5 mm every set (50 sheets) in the x - plane and no set offset in the z-plane.	Detect a bad stack of 200 sheets with an offset of 5 mm every set (50 sheets) in the x- plane and no offset in the z-plane.	The device should be able to detect a bad stack of 200 sheets with an offset of 5 mm in the x-plane but not z-plane
The set offset is not regular and does not return to “no offset” every other set.	Detect stacks that do not return to the “no offset” every other set.	The device should be able to detect stacks that don’t offset.
A bad stack of 200 sheets with no regular set offset in the x-plane or the z-plane.	Detect a bad stack of 200 sheets with no regular set offset in the x-plane or the z-plane.	The device should be able to detect a bad stack of 200 sheets with no regular offset in the x-plane or z-plane.
Within a stack of 200 sheets, at least one sheet is offset from the bottom sheet in the set by more than 5 mm in any direction.	Detect an offset of more than 5 mm in a stack of 200 sheets.	The device should be able to detect an offset of any more than 5 mm in 200-sheet stack.
Consideration will be given to projects that achieve the desired spec & minimize cost.	Cost effective.	The product should be cost effective.

The table above shows the customer needs, the needs statements, and the objective statements for the project. From looking at the needs, we could clearly see what Xerox wanted from this project; Xerox needs a device that can be installed in the iGen4 digital printing press and can measure the quality of a 200-sheet stack of paper. They also need the device to be cost effective; this machine costs thousands of dollars, and creating an expensive device would only drive the cost up. This could result in the loss of customers.

6.0 Generated Ideas

After brainstorming we came up with three general ideas. We weighed the pros and cons of each idea and determined which one will be the best with the customer and the company in mind.

- A series of lights being shot at photocells, which will determine a good offset stack vs. a bad offset stack. The lights would be positioned so that when the stacks are set properly, the lights would be covered. This means that a bad stack would not obstruct the path of light, which would then hit the photocell, detecting a bad stack.

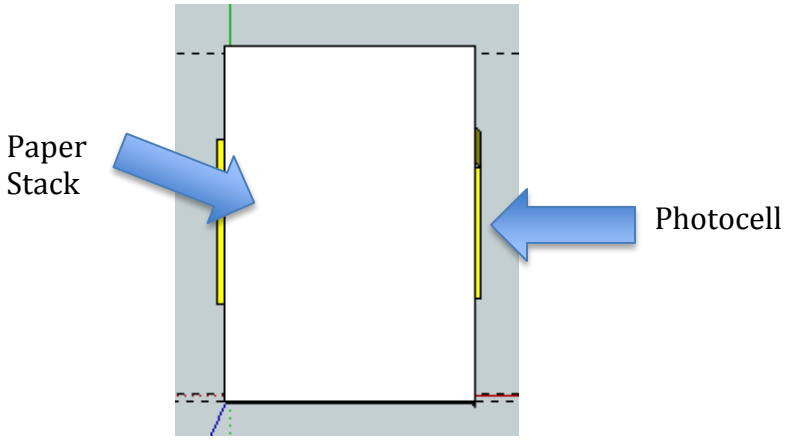

Figure 1: Top View

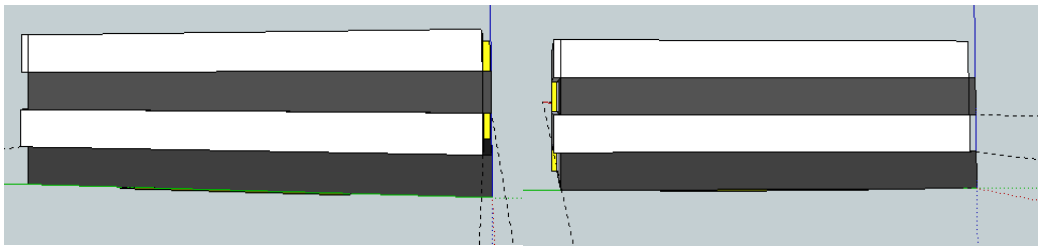

Figure 2: Side Views

- A Force sensor would be used to tell the machine when to offset the paper. The paper would fall and the position would register with the sensor; the sensor would then detect if the paper was positioned where is should be.
- A pressure sensor would be used to determine when to offset each stack. This idea is similar to the first

7.0 Final Product

The first concept is the concept we decided to expand on. We decided to go with this idea because of our criteria: cost, functionality/effectiveness, and practicality. Our final design was the only one to pass all three tests. The idea is based around light and sensors to detect that light. Inside the printer, there would be 8 LED lights; 4 on the ceiling of the printer and 4 on the walls of the printer. The lights would be offset to match the proper offset of the paper (i.e. 5 mm in the x-plane, etc.) One photocell would be place directly across from the light. If the paper stacks properly, the lights would remain uncovered, allowing the light to hit the sensor. If the stacks were "bad," the stack would cover the light; this would change the resistance in the photocell. The printer would sense a change and a bad stack would be detected.

Specifications:

- The product would have the following pieces:
  - 8 LED lights
    - 4 for the x-plane, 4 for the z-plane
  - 8 Photocells to correspond with the LEDs
  - 1 battery to power the system
  - Resistors for the system
- Diameter of beam (if laser or higher quality light is used): 5.5 mm
- Light shines in y-direction the width of printer
  - Detects offset in x-direction
- Light shines down in z-direction
  - Detects offset in z direction

How the device works:

An LED light focuses light a photocell and the resistance decreases. When a bad stack occurs, the light on the photocell will be blocked resulting in an increase of resistance. We measured this with a multi-meter. In a final company product, the parts and measuring devices will be more advanced and will send results to a computer

7.1 Final Product: Costs

All the parts of this device would cost as follows:

- Resistor (220 ohms): $1.19x2=$2.38
- 9Volt Battery: $6.99x1=$6.99
- Photo Transistor: $1.99x8=$15.92
- LED Light: $0.84x8=$6.72

Total Cost: $32.01

8.0 Conclusion

We believe this product would be a great addition to the Xerox iGen4 for many reasons. This device is cost effective and accurate, as well easy to use. The photocells would do all the work. As long as the lights and sensors were placed in the proper positions, the device would be very accurate, and would be able to properly determine good and bad stacks. This device is also inexpensive; the total cost comes to $32.01, which, compared to the total cost of the iGen4, is relatively cheap. We believe that our device would be a great addition to the Xerox iGen4 for the reasons listed above, and it would be beneficial to both Xerox and their customers.

References

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