Colorimetric Determination of Somatic Cell Count (SCC)

Submitted to:
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The Senior Design Project Committee
Mechanical Engineering and Mechanics Department
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Team Number: MEM-29

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ABSTRACT

Infections in the udder of a cow can lead to an inflammation of the udder called bovine mastitis. Leukocytes are somatic (non-reproductive) cells formed as defenses by an organism in response to infections. Since higher cell counts are associated with poorer quality milk and possibly mistreated cows, they are a food safety concern and are thus regulated by government agencies around the world. The somatic cell count for Grade A milk is defined by the USDA as being 750,000cells/ml. The upper limit for the EU is 400,000/ml. A farm with a cell count of 200,000 or below will typically be more profitable. Bovine Mastitis, an inflammation of the udder is highly correlated with elevated somatic cell counts in milk. The treatment cost and reduction in production is responsible for causing the dairy industry to lose more than $1.8billion every year. In its early stages, sub-clinical mastitis, the disease shows no obvious signs. This project aims to create an accurate, inexpensive measuring device that can be used on-site with little training or maintenance. This endeavor is a continuation of a project initiated by the 2006 MEM26 team. The method of cell count measurement was developed by PortaScience, inc. It is an optical method that involves measuring the reflectance change of a dyed sample of milk. This electromechanical device will use few custom components for lowered cost. It will be battery operated for portability. This requires low power components and design for this constraint. The data will be stored and processed using a custom coded Programmable Logic Controller (PLC), and interface to a desktop or laptop computer.

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INTRODUCTION

Problem Background

Milk is a complex fluid nutrient source composed primarily of water, sugar, protein, fat, minerals, enzymes, and cells. Through pasteurization, milk is processed to reduce the cell count in order to reduce likelihood of disease and increase shelf life. The number and type of microorganisms present in raw milk are a function of the cow's health. The primary indicator of udder health is the bovine somatic cell count.

Somatic cells are broadly defined as cells that an organism does not use for reproduction such as sperm and ova. In the context of the dairy industry, the cells of focus are leukocytes- white blood cells. When an infection is present these cell count will rise in an effort to destroy the invading body and repair damage. This infection may develop into an inflammation of the udder called mastitis. If there are no signs of inflammation, the mastitis is sub clinical while if there are signs, it is clinical mastitis. This natural response has two major implications for the dairy farmer: reduced milk production due to stress and lower quality milk due to the enzymes remaining after the bacteria is destroyed.

Cell count is regulated to protect the consumer. The upper limit for bovine somatic cell count is set by the United States Department of Agriculture to be 750,000 cells/ml in the US and 400,000cells/ml by the European commission in EU nations. Dairy farmers receive bonuses for milk with lower cell counts but may be investigated for counts over the legal limits.

In the US, the dairy industry loses 1.8billion/year due to treatment of mastitis and reduced production. Both forms of mastitis are communicable between cows through environmental interaction, or by human transfer during milking. A cow infected with Mastitis has an average decrease in milk production of $1600 per year. Early detection of the disease is the key to treating and preventing the spread of the infection, and therefore, it would be beneficial to dairy farmers to have an on-site method of testing their cows for elevated SCC counts. It is estimated that for every clinical case of mastitis there will be between 15 and 40 cases of Sub-clinical Mastitis (Welcome).

There are 4 popular methods of detection: lab testing which is expensive and may take weeks for results, California Mastitis Test (CMT) which is inexpensive and fast but not accurate, the Delaval cell counter, which is accurate but expensive, not portable, and not quick, and the Portascience PortaSCC which is inexpensive and portable but not quick.

Portascience has developed an optical method for counting somatic cells. This was the subject of the 2006 MEM26 design project. MEM26 demonstrated that cells could be counted quickly but was unable to achieve a high level of accuracy.

Problem Statement

There are currently no devices or methods to accurately and inexpensively measure bovine somatic cell count on the order of seconds. There is no device which is both handheld and accurate with respect to a lab test. There are no devices which can be easily configured to test continuously in an inline fashion.

The goal of this project is to develop a device that can count the somatic cells in a sample of milk with high correlation to lab equipment.

Constraints on the Solution

- Final Product must not exceed the size of current prototype.
    - No larger than 22cm x 22cm x 17cm
    - Must be portable, weigh less than 4.1 kg.
- Run at least 300 tests consecutively without clogging or buildup.
- Integrate current optical detection system created by PortaScience.
- Run on rechargeable battery.
- Have internal reservoirs to hold dye substrate, buffer solution, and washing fluid for 300 tests.
- Must be completed by April.
- Simple to operate
    - Simply turn on button and add sampled milk.
- Track somatic cell count data for 150 cows.
- Must have results in about a minute as was achieved by prototype.
- Must keep samples and pluming clean, as was achieved by prototype.
- Must be durable to survive farm conditions.
- Must be low powered.
    - Few moving parts.

    - Battery operated.
- Must be environmentally friendly
- Detect from 0 to 2 Million cells/ml +/-5000cells

Product and Literature Review

There are four main devices to diagnose Mastitis by analyzing white blood cell count in the udder: sending samples to a laboratory, the California Mastitis Test (CMT), the Delaval Cell Counter (DCC), PortaSCC milk tester. Laboratories use particle analyzers such as the Fossomatic Series and the Bentley SomaCount Series to count the individual white blood cells. In particular, the Bentley SomaCount 500 utilizes flow cytometer laser to produce results that are very accurate (100k to 5M, within 10% typically). Since the equipment is kept in a laboratory, milk samples must be packaged and mailed; hence, the results can take several days to obtain.

Alternatively, the CMT is a cow side test that takes up to 10 seconds to obtain a result. Described in Schnarl and Noorlander's 1957 paper, *Experiments and observations Leading to development of the California Mastitis Test*, a reagent is mixed with milk that causes the viscosity of the mixture to rise with the presence of leukocytes. The test is not very sensitive and is thus difficult to quantize. The test is reliable for cell counts greater than 500,000 cells/mL, but it can give a rate of false negatives ranging from 8% to 43% for lower cell counts, depending on the score used as the threshold for infection. The test is designed to be manually measured and interpreted, though for bulk tank mixtures an automated method, called the Wisconsin Mastitis Test is used.

The Delaval Cell Counter (PAT. NO. 6,971,330) is an automated portable somatic cell counter capable of rendering results in under a minute. The milk sample is collected on a special cassette that is then inserted into the counter. The device is also accurate with a coefficient of correlation of 0.92 with respect to the laboratory equipment, such as the Bentley SomaCount Series. However, this cell counter is costly; it is sold for over $3000 per unit, plus the cost of the one-time-use cassettes.

The PortaSCC milk tester is not as accurate as the aforementioned methods, whose results are liquid phase detectors. It has a coefficient of correlation of 0.81 with respect to the laboratory test equipment, and the results take up to 45 minutes to obtain.

This method requires test strips that are sensitive to direct light, extreme temperature, and high humidity.

The 2006 MEM-26 team, in collaboration with PortaScience, designed and built a prototype of an automated, portable somatic cell counter. This system was designed to use a dye that reacts with the white cells in the sampled milk and turns the mixture blue. In theory, the intensity of the blue wave is read by an optical sensor and an onboard LCD displays the count of the white cells. However, the system is in need of a complete redesign as the sensors, control system, enclosure, fluid dynamics, and software did not meet specifications. The optical sensor subsystem does not deliver reliable data. This was due to the flow cell design and choice of components. The control system and all software are mostly incomplete and must be redesigned and implemented. The enclosure is not farm proof and is not guaranteed to provide adequate mechanical and thermal support for the internal subsystems. The plumbing for the system might be implemented in a more efficient and cost effective way than was not considered previously. This team will deliver a practical, portable, durable, robust, functional instrument.

STATEMENT OF WORK

Method of Solution

This system is composed of primarily electrical, electronic, software, and mechanical engineering.

- Optics

Color is perceived by the reflection of wavelengths not absorbed by an object. The proposed system will measure the reflectance of the milk/dye solution so optics is key. This will require an optimum optical configuration involving the selection of appropriate window materials and dimensions, viewing enclosure, elimination of outside noise, elimination of bubbles, and the appropriate selection of sensor. It is known that when the milk is mixed with the dye, peak brightness occurs at 620nm. Possible sensors are a photodiode or an LED. Photodiodes measure brightness over a relatively broad

range compared to LED's. LED's built with materials using the same properties as photodiodes can be run in reverse to detect light of the same wavelength that it would produce. If enough current could be generated, the LED would be a better solution since it would be easier to match sensor with the source since they would be components of the same type.

- Amplifiers

Amplifiers will be required both for the sensors and for the control outputs. The sensor output is expected to be very weak and the differentials will thus be smaller. To increase resolution, the signals must be amplified with a gain determined partly by the requirements of the Analog to Digital Converter (ADC). If an all silicon control system is used, it is unlikely that the chip will be able to drive a large enough power signal to operate the valves and motors. The amplifiers may be either Operational amplifiers (op-amps) or simple discrete transistors. Op-amps are simple to operate and are versatile but usually require a lot of power. Transistors are more complicated to bias and may require more overall space, but may use less power.

- Control

A low power programmable logic controller will be investigated as it offers the most convenient way to interface with a computer and control the entire electromechanical device. The controller will process all information from every sensor and store it onboard. It will also precisely control every mechanical process from pumping to mixing. The required processor would not need a sample rate since samples are not expected to change much over time. The processor would not need to be very fast as the most complicated function it would perform would be interpolation of the sampled data which is a simple arithmetic operation. It would need either a serial or parallel interface in order to communicate with the computer. Controllers with these features and more can be found which operate at 1.8V in the uA range yet cost only a few dollars a chip.

❖ Power

In order for this device to be portable it must be battery operated. In order to increase the time between charges, everything must use as little power as possible. The power system must be regulated and protected from faults.

❖ Software

A personal computer interface will be developed that will easily allow the extraction of data from the device. This will provide for much longer storage of data and the ability to perform more operations. This will require GUI and port programming. The interface must be user friendly and bug-free.

❖ Flow Cell

In creating a more optimal design, a component within the system in need of some modification was the flow cell. The flow cell has two important functions that perpetuate the system. It serves as the mixing chamber, in which it is the location where the liquid components merge, as well as the optical cell where the fiber optic probes gauge the mixture. These are critical aspects of entire system considering that improper and flawed analyses deem the entire system ineffective. Hence, some vital constraints for the flow cell are that it must be easy to clean, permeable to transmitted light, and the volume capacity must be properly measured.

Due to the variances in the initial viscosities of the cow's milk and chemical components, it is possible that flow cell could be fated to develop a build up of the mixture in the chamber, even after the cleansing and buffering processes. This mishap will contaminate the prospective samples, and intrinsically, interfere with the optic readings. To prevent this, the chamber's corner will be rounded, even though the segment in which the reading with be administered will be a rectangular shape.

Another constraint for the flow cell is the performance of the material used for the construction of the flow cell. The material must be lightweight, as well as have the capabilities of allowing light to be transmitted. The material would have to absorb light in the likeness of a dark material.

In addition to these considerations, we opted to improve the upper plate of the cell by making it thinner. This improvement will not only reduce the amount of the required material, but it will be easier to assemble, and to machine during the manufacturing process. Also, it's ideal to add a compressor stop to the lower part of the flow cell to ensure that there will be no over compression of the gasket material.

- Valves

In the previous design of this device, a solenoid valve was employed as a control element to obstruct and release the fluid(s). Basically, a solenoid valve is an electromechanical valve, for applications with liquid or gas, that is manipulated via running or stopping an electrical current through the solenoid. This is what converts the electrical energy into mechanical energy, affording the desired results to the user.

The solenoid valve is very helpful in that it offers fast and safe switching, high reliability, long service life, and compact design. Consequently, its applications range from central heating and thermostats to uses in the paintball industry. For this reason, the solenoid valve was worthy of consideration.

While the solenoid valves are very favorable to our design, they are very expensive, and do not favor our budget goals. The utility of the solenoid valves is unquestionably worth regarding; however, we are committing ourselves to further research for a quality-equivalent valve that better complies to our financial aims.

ECONOMIC ANALYSIS

By using few custom components, it is believed that a low cost device that meets the established criteria for accuracy and speed can be constructed. Semiconductor devices can fulfill the needs of nearly every electronic aspect of this project. Thus, the electronic parts and materials will thus be very inexpensive to obtain and will be even cheaper in bulk. The only custom components will be the printed circuit board and enclosure. Additional cost consideration must be given to assembly. The components that may prove to be unavoidably expensive are the valves and pump.

Market Study

This device will be produced and marketed specifically to dairy producers. Mastitis can cause heavy losses due to spread of infection and the inability to adequately detect it early. Because of this, both small and large farms would readily benefit from a device that can continuously and accurately monitor somatic cell count through either inline or handheld configuration. The most similar product is the CMT which though not as accurate, is fast and inexpensive and provides a useful general measure. It is also the most inexpensive, costing $190 for the kit plus $0.10 per test. The PortaSCC meets all requirements except that tests can take up to 45min. It costs 250 + .20/test. The Delaval Cellcounter is the most accurate but is also the slowest and is not portable. It costs 4000 + 2.00/test. To remain competitive the device should cost around $200 however the market demonstrates that a $4000 machine will sell.

SOCIETAL AND ENVIRONMENTAL IMPACT

Customary in many cultures of the world, in particular the Western world, humans continue to consume milk beyond infancy, using the milk of cows as a food product. For hundreds of years, cow's milk has been processed into dairy products such as cream, yogurt, butter, ice cream, and cheese. In addition to these, industrial science has afforded our society whey protein, condensed and powdered milk, lactose, casein, and other food-additive and industrial products. Dairy products continue to be a significant component in our society, and therefore should be of the highest quality possible.

The expense per gallon of milk disbursed by milk packaging companies is dependent upon the SCC: (e.g. - If the SCC is ≥ 500,000 cells/mL, then the dairy farmer is penalized for negligence with the health of his cows. Inversely, if the SCC is ≤ 250,000 cells/mL, then the dairy farmer will receive a bonus. In all cases, the ultimate limit, legalized by the Food and Drug Administration (FDA), is 750,000 cells/mL, and if reached, the dairy farmer's operations will be halted and further scrutinized in order to survey the quality of care and attention given to the cows.)

In the research and further development of our device, we have begun to take inventory of the many parts and components of the design, with consideration of the societal impact. Some of the many things that we considered were the source of power and the amount of milk sample, dye substrate, and buffer solution necessary for the analysis and the clean-up. These considerations were to ensure that our device and its components are environmentally friendly and ergonomic, fostering a minimal amount of waste, and comprised of materials that optimize the results while being risk-free. All of the liquids in our device, alone, as well as mixed together, are non-toxic and can be easily discarded with no detrimental effects.

CONCLUSION

Early, rapid detection of signs of bovine mastitis will lead to a significant decrease in losses for the dairy industry. This project will develop a durable electromechanical system that utilizes the optical properties of milk to develop a reliable, inexpensive device that can quickly count leukocytes in milk. The device will be easy to use and handheld but will also be designed with the ability to function in an inline capacity in order to work as another functional part of the automated farm.

REFERENCES

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Appendix A: Project Management Timetable

#	Tasks	Days	Start	Finish	%	Cost	Assignments	Notes
1	**Proposal Draft**	4	11/15/2007	11/20/2007	0	$0.00		
2	Abstract	1	11/15/2007	11/15/2007	0	$0.00	Harold Edwards, Kelvin Johnson, Tobias Nteireho, Luisnel Cuello	
3	Introduction	1	11/15/2007	11/15/2007	0	$0.00	Harold Edwards, Kelvin Johnson, Tobias Nteireho, Luisnel Cuello	
4	Existing Solutions	1	11/15/2007	11/15/2007	0	$0.00	Kelvin Johnson	
5	Optics	1	11/15/2007	11/15/2007	0	$0.00	Luisnel Cuello, Tobias Nteireho	
6	FlowCell	1	11/15/2007	11/15/2007	0	$0.00	Kelvin Johnson, Harold Edwards	
7	Processor Writeup	1	11/15/2007	11/15/2007	0	$0.00	Tobias Nteireho, Luisnel Cuello	
8	Relays/Valves/Pumps Writeup	1	11/20/2007	11/20/2007	0	$0.00	Harold Edwards, Kelvin Johnson	
9	Budget	1	11/20/2007	11/20/2007	0	$0.00	Luisnel Cuello	
10	Societal and Environmental Impacts	1	11/20/2007	11/20/2007	0	$0.00	Harold Edwards	
11	Market Study and Economic Analysis	1	11/20/2007	11/20/2007	0	$0.00	Tobias Nteireho	
12	Conclusion	1	11/20/2007	11/20/2007	0	$0.00	Harold Edwards, Kelvin Johnson, Tobias Nteireho, Luisnel Cuello	
13	Future Works	1	11/20/2007	11/20/2007	0	$0.00	Tobias Nteireho	
14	Write Existing Solutions Writeup	1	11/20/2007	11/20/2007	0	$0.00	Kelvin Johnson	
15	Write Societal and Environmental Impacts for Proposal	1	11/20/2007	11/20/2007	0	$0.00	Harold Edwards	
16	Market Study and Economic Analysis	1	11/20/2007	11/20/2007	0	$0.00	Tobias Nteireho	
17	Write Budget	1	11/20/2007	11/20/2007	0	$0.00	Luisnel Cuello	
18	**Proposal Presentation**	1	11/26/2007	11/26/2007	0	$0.00		
19	What to Keep/What needs Improvements	1	11/26/2007	11/26/2007	0	$0.00		

20	Optics	1	11/26/2007	11/26/2007	0	$0.00	Luisnel Cuello, Tobias Nteireho	
21	Flow Cell	1	11/26/2007	11/26/2007	0	$0.00	Kelvin Johnson, Harold Edwards	
22	Processor	1	11/26/2007	11/26/2007	0	$0.00	Luisnel Cuello, Tobias Nteireho	
23	Relays/Valves/Pumps	1	11/26/2007	11/26/2007	0	$0.00	Kelvin Johnson, Harold Edwards	
24	Introduction	1	11/26/2007	11/26/2007	0	$0.00	Harold Edwards, Kelvin Johnson, Tobias Nteireho, Luisnel Cuello	
25	Existing Solutions	1	11/26/2007	11/26/2007	0	$0.00	Kelvin Johnson	
26	**Experiments**	102	11/19/2007	4/8/2008	0	$0.00		
27	LED/Photo Cell vs. LED/LED	1	1/7/2008	1/7/2008	0	$0.00	Luisnel Cuello, Tobias Nteireho	
28	Pump Testing	1	1/28/2008	1/28/2008	0	$0.00	Kelvin Johnson, Harold Edwards	
29	Filter Testing	1	1/28/2008	1/28/2008	0	$0.00	Harold Edwards, Kelvin Johnson, Tobias Nteireho, Luisnel Cuello	
30	Battery Testing	43	1/28/2008	3/26/2008	0	$0.00	Harold Edwards, Kelvin Johnson, Tobias Nteireho, Luisnel Cuello	
31	Prototype Testing	47	2/4/2008	4/8/2008	0	$0.00	Harold Edwards, Kelvin Johnson, Tobias Nteireho, Luisnel Cuello	
32	Meet with Kelvin to discuss Plans on Flow Cell	15	11/19/2007	12/7/2007	0	$0.00	Harold Edwards	
33	Meet with Harold to discuss Flow Cell Design	15	11/19/2007	12/7/2007	0	$0.00	Kelvin Johnson	
34	Think about Flow of System	36	11/19/2007	1/7/2008	0	$0.00	Harold Edwards, Kelvin Johnson, Tobias Nteireho, Luisnel Cuello	
35	Meet with Luis to discuss Optics	15	11/19/2007	12/7/2007	0	$0.00	Tobias Nteireho	
36	Meet with Tobias to discuss Optics	15	11/19/2007	12/7/2007	0	$0.00	Luisnel Cuello	
37	Research Pump	21	12/10/2007	1/7/2008	0	$0.00	Kelvin Johnson	
38	Research processors	21	12/10/2007	1/7/2008	0	$0.00	Tobias Nteireho	

39	Research Amplifiers and LED	21	12/10/2007	1/7/2008	0	$0.00	Luisnel Cuello	
40	Research Filters	21	12/10/2007	1/7/2008	0	$0.00	Harold Edwards	
41	**Design of Preliminary Prototype**	10	1/7/2008	1/18/2008	0	$0.00		
42	Order Parts	5	1/14/2008	1/18/2008	0	$0.00	Harold Edwards	
43	FlowCell Preliminary Design	5	1/7/2008	1/11/2008	0	$0.00	Harold Edwards, Kelvin Johnson	
44	Optics Preliminary Design	5	1/7/2008	1/11/2008	0	$0.00	Tobias Nteireho, Luisnel Cuello	
45	Flow of System Preliminary Design	5	1/7/2008	1/11/2008	0	$0.00	Harold Edwards, Kelvin Johnson, Tobias Nteireho, Luisnel Cuello	
46	Control Program Preliminary Design	5	1/7/2008	1/11/2008	0	$0.00	Harold Edwards, Kelvin Johnson, Tobias Nteireho, Luisnel Cuello	
47	Create Spreadsheet for Ordering Parts	1	1/11/2008	1/11/2008	0	$0.00	Harold Edwards	
48	Testing of Prototype	5	2/4/2008	2/8/2008	0	$0.00	Harold Edwards, Kelvin Johnson, Tobias Nteireho, Luisnel Cuello	
49	**Design of Final Prototype**	20	2/11/2008	3/7/2008	0	$0.00		
50	Optics Final Design	20	2/11/2008	3/7/2008	0	$0.00	Luisnel Cuello, Tobias Nteireho	
51	Flow of System Final Design	20	2/11/2008	3/7/2008	0	$0.00	Harold Edwards, Kelvin Johnson, Tobias Nteireho, Luisnel Cuello	
52	Flow Cell Final Design	20	2/11/2008	3/7/2008	0	$0.00	Kelvin Johnson, Harold Edwards	
53	Control Program Final Design	20	2/11/2008	3/7/2008	0	$0.00	Harold Edwards, Kelvin Johnson, Tobias Nteireho, Luisnel Cuello	
54	**Final Paper**	56	2/11/2008	4/28/2008	0	$0.00	Harold Edwards, Kelvin Johnson, Tobias Nteireho, Luisnel Cuello	
55	Introduction	2	2/11/2008	2/12/2008	0	$0.00	Harold Edwards, Kelvin Johnson, Tobias Nteireho, Luisnel Cuello	

56	Method of Solution	21	3/31/2008	4/28/2008	0	$0.00	Harold Edwards, Kelvin Johnson, Tobias Nteireho, Luisnel Cuello	
57	Design Feasibility	21	3/31/2008	4/28/2008	0	$0.00	Harold Edwards, Kelvin Johnson, Tobias Nteireho, Luisnel Cuello	
58	Considerations for Alternatives	21	3/31/2008	4/28/2008	0	$0.00	Harold Edwards, Kelvin Johnson, Tobias Nteireho, Luisnel Cuello	
59	Proposed Approach for Analysis	21	3/31/2008	4/28/2008	0	$0.00	Harold Edwards, Kelvin Johnson, Tobias Nteireho, Luisnel Cuello	
60	Testing and Design Validations	21	3/31/2008	4/28/2008	0	$0.00	Harold Edwards, Kelvin Johnson, Tobias Nteireho, Luisnel Cuello	
61	Economic Analysis	21	3/31/2008	4/28/2008	0	$0.00	Harold Edwards, Kelvin Johnson, Tobias Nteireho, Luisnel Cuello	
62	Budgets and Schedules	21	3/31/2008	4/28/2008	0	$0.00	Harold Edwards, Kelvin Johnson, Tobias Nteireho, Luisnel Cuello	
63	Considerations for Societal, Environmental and Ethical impacts	21	3/31/2008	4/28/2008	0	$0.00	Harold Edwards, Kelvin Johnson, Tobias Nteireho, Luisnel Cuello	
64	Summary, Conclusion	21	3/31/2008	4/28/2008	0	$0.00	Harold Edwards, Kelvin Johnson, Tobias Nteireho, Luisnel Cuello	
65	Final Presenation	21	3/31/2008	4/28/2008	0	$0.00	Harold Edwards, Kelvin Johnson, Tobias Nteireho, Luisnel Cuello	

Appendix B: Resumes

Harold L. Edwards, Jr.

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Sewell, NJ 08080 *E-MAIL: hle22@drexel.edu*

EDUCATION

Drexel University, Philadelphia, PA
Bachelor of Science in Mechanical Engineering: expected June 2008; Music Minor

HONORS

- Exelon Endowed Scholar (2005—present)
- Raymond Joseph Harris Educational Fund Scholar (2005/2006)
- D.C.A.E. Certificate of Academic Achievement for 2003/2004
- Graphic Communications Scholarship Recipient (2003)
- Henry W. M. Memorial Scholar (2003-present)
- Fay Mor Wee Scholarship Recipient (2003)
- N.J.H.G.C. Excellence Scholarship Recipient (2003)

EXPERIENCE

Kinetix, Chester, PA — *October 2005 - March 2006*
Project Engineer

- Assisted Senior Project Manager and Chief Estimator in bidding projects, submittals, RFI, contracts, purchase orders, and onsite project coordination
- Created partnerships with vendors and subcontractors for equipment/material purchasing and shipping, and project scheduling
- Organized and prepared financial models for future projects to be bided

Atlantic County Division of Engineering, Northfield, NJ — *September 2004 - March 2005*
Engineering Aide

- Assisted in surveys and mechanical inspections of county bridges in need of restoration
- Served as a County Road Inspector
- Monitored and surveyed outside contractors for quality assurance
- Developed and implemented identification codes for county roadway signals
- Acquired knowledge of stress and strain of materials such as asphalt, concrete, and steel

COMPUTER SKILLS

SOFTWARE: LabView, Simulink, AutoCAD, Pro-Engineer, Maple, Macromedia Dreamweaver, Fireworks/Flash, Microsoft Word/Excel, CarteGraph, ADAMS, Window XP, Mac OS, and Internet research applications

INTERESTS

- Drexel Minority Achievement Program — Academic Chairperson
- Selah Levitical Ministries, Inc. — Vice President, Director of Music
- Alliance of Minority Participation (AMP)
- Member of Drexel University Gospel Choir
- Hobbies: music, martial arts, design (Fashion Design/Object Modeling), golf, cooking

TRAINING

- Covey Institute Training — July 2003 - August 2003
  The 7 Habits of Highly Effective People
- Organization Behavior — June 2007 – September 2007

Luisnel Cuello 267-975-4635
3417 Tyson Ave luisnel.cuello@drexel.edu
Philadelphia, PA 19149

Education Drexel University, Philadelphia, PA
Bachelor of Science in Electrical Engineering, Minor in Mathematics
Anticipated Graduation- June 2008
Cumulative GPA: 3.01/ 4.0 Dean's List 2004-2005

Computer Skills
Software: Microsoft Windows, Microsoft Office, PSPICE, Cadence, ADS 2006A, Java, MATLAB, AutoCAD 2004, Mac OS, Maple, OrCAD, LabVIEW 6i

Experience

Cingular Wireless King of Prussia, PA
RF Support Analyst September 2006 to March 2007

- Composed and distributed daily reports to engineers to assist in optimizing GSM network.
- Developed Microsoft Excel Macro for E-911 program that reduced the time to detect non-triangulated 911 calls.
- Created Microsoft Excel Macro to generate network metrics for newly integrated UMTS technology.
- Utilized TEMs program to monitor signal strength and dropped calls for the GSM network throughout Eastern and Central Pennsylvania.
- Trained engineers to operate TEMs program for new UMTS technology.

Ametek Aerospace Sellersville, PA
Engineering Assistant September 2005 to March 2006

- Supported the development of a test set for Boeing E-03 and E-08 fuel indicating system.
- Aided Engineers in subjecting fuel probes to stress, strain and fuel susceptibility tests.
- Simulated a fuel probe test set using Microsoft Excel.
- Designed and implemented special test set cables for fuel probe data collection.
- Packaged and shipped fuel system parts to other facilities for testing.

Sarnoff Corporations Princeton, NJ
Engineering Assistant September 2004 to March 2005

- Tested materials and electrical components during research and development of two biological agent collectors.
- Utilized electrostatic sprayer to test the ability to evenly distribute antibodies over a stint.
- Modeled and fabricated a switching circuit using OrCAD for biological agent collectors.
- Documented experiments performed to use for input in monthly research reports.
- Assisted in development of a golf ball finder by analyzing photos of golf balls with various backgrounds and tested them by applying an algorithm.
- Developed knowledge of electrostatics by experiment design as well as how to prepare, analyze, and present data with guidance from an experienced Electrical Engineer.

Training Covey Institute Training July 2003 - August 2003
The 7 Habits of Highly Effective People

National Institute for Leadership Advancement (NILA) August 2004
Trained in leadership, teamwork and organizational problem solving through workshops and projects

Activities Alpha Phi Omega, National Service Fraternity Inc. - Vice President of Fellowship, 2004-2006
Society of Hispanic Professional Engineers – Ext. Vice President- Drexel Chapter, 2003-2004
SHPE Dance Team, Choreographer and Director, 2003-2004
Institute of Electrical and Electronics Engineers
Asbury Ministry Rebuilding New Orleans Project
Drexel Intramural Field Hockey

Languages Fluent speaking, writing, and reading skills in English and Spanish

Tobias N Nteireho
tobias.ngazoire.nteireho@drexel.edu
3FL Apt • 3806 Hamilton St • Philadelphia, PA 19104 • 703-626-3287

Education

Drexel University, Philadelphia, PA
Bachelor of Science in Electrical Engineering, June 2008
Advanced Electronics and RF/Antennas, Member IEEE, ACM

Experience

University of Pennesylvania, Philadelphia,PA

IT Tech Support/Consultant, 03/2006 - 03/2007

Performed first tier tech support and troubleshooting. Provided product reviews of various technologies and devices. Helped to deploy and transition to the new wireless network, AirPennNet, through testing, documentation, and consulting

Guideworks/Comcast/TvGuide, Radnor, PA

Co-Op Software Engineer, 3/2005 - 9/2005

Developed a multithreaded, real-time, serial port DCT diagnostic client and other in-house tools to further the development of the Comcast/TvGuide embedded Guide Software for Motorola and OCAP Digital Cable Terminals. Worked with C, C++, Visual Basic, perl, win32 API, HTTP sockets and MFC.

tDEC Freshman Design Project, Drexel University

Project Lead, 12/2003 - 5/2004

Directed a team of 4 others in the effort to design and present a standard form factor for laptop computers including dimensions, power and standard ports and interfaces based on extensive research of current and past needs and trends.

Yousif Family, Vienna, Virginia

Computer Science Tutor, 9/2002 - 6/2003

Prepared high school sophomore for AP Computer Science AB Exam through review of hashes, linked lists, trees, stacks, queues, sorts and searches, the student's source code and a reinforcement of style conventions of C++

First Objective Software, Alexandria, Virginia

Applications Developer, 3/2000 - 6/2002

Ported CMarkup XML library to Delphi from C++ and designed and developed solutions for Windows, DOS, Unix and variants, and Macintosh using C++, Delphi, MFC, wxWindows.

Skills

Computer Languages:	C/C++, Java, MATLAB, Delphi/Kylix, Maple, PHP, Javascript, HTML, CSS
API:	MFC, win32, SDL, OpenGL, wxWindows, CMarkup
Development:	Visual Studio, Cadence, PSpice, XCode, Apache, LabView, GCC
Graphics:	Adobe Premiere, Casablanca, AutoCad, Gimp, Photoshop, dia
Office Software:	MS Office, OpenOffice.org, Gnucash
Operating Systems:	Windows 95-Vista, Linux, MacOS 8-X, MS-DOS, FreeBSD
Window Managers/Desktops/Shells:	KDE, GNOME, TWM, Midnight Commander (MC), BASH
Certifications:	Comptia A+ and Linux+

Leadership

Rush Chairman Alpha Phi Omega, Zeta Theta	Fall 2006
Vice President Service Alpha Phi Omega, Zeta Theta	2004-2006

Kelvin F Johnson

145 Disney Ct
Owings Mills, MD 21117
443-744-2755
kelvin.floyd.johnson@drexel.edu

Education

Drexel University, Philadelphia, PA
Bachelors of Science in Engineering, Anticipated Graduation - June, 2008
Mechanical Engineering

Computer Skills

Operating Systems: Windows 2000/ME/XP
Software: MS Office, AutoCAD 2006, Maple 8, Lab VIEW 7, FEMAP, EPIC, Pro Engineer Wildfire 2.0

Relevant Coursework

Statics
Dynamics
Fluid Mechanics
Heat Transfer
Manufacturing Processes
Thermodynamics I II
Mechanics of Materials
Micro-Processing Control System

Experience

Alion Science & Technology, Washington D.C.
Engineer, Shock, Structures & Advanced Materials Group, April 2007 to September 2007

- •Performed technical analysis relating to shock qualification tasking for the VIRGINIA CLASS Program Office (PMS450). Support involves performing technical reviews and presenting written recommendations concerning sufficiency of VIRGINIA Class shock design deliverables, including Shock Extension Requests, Shock Test Procedures and Shock Test Reports.
- • Completed engineering design and analysis on ship structures using FEMAP software to mathematically model and analyze the structure
- •Performed Finite Element modeling of Ballistic Impacts using EPIC. Ballistic limit predictions for small arms projectiles and armor configurations were devised and the validation of the results determined using the EPIC program.

The RealWinWin, Philadelphia, PA.
Assistant Engineer, March 2006 to September 2006

- • Researched HVAC unit and lighting fixture specification sheets in order to optimize energy savings for prospective clients
- • Reviewed architectural rooftop and mechanical drawings to calculate rebate incentives
- • Screened projects for updates on construction dates and building specifications

The Solo Cup, Owings Mills, MD
Plant Manufacturer, June 2005 to September 2005

- • Responsible for packaging and product efficiency on assembly lines
- • Assisted with the operations of manufacturing machinery

Activities

- •Drexel University Intramurals Official (2003-2007)
- •Founder and C.E.O. of EduCaking Games LLC. –Board Game/Toy Company
- •Drexel University Society of Entrepreneur Engineers (2005-2007)